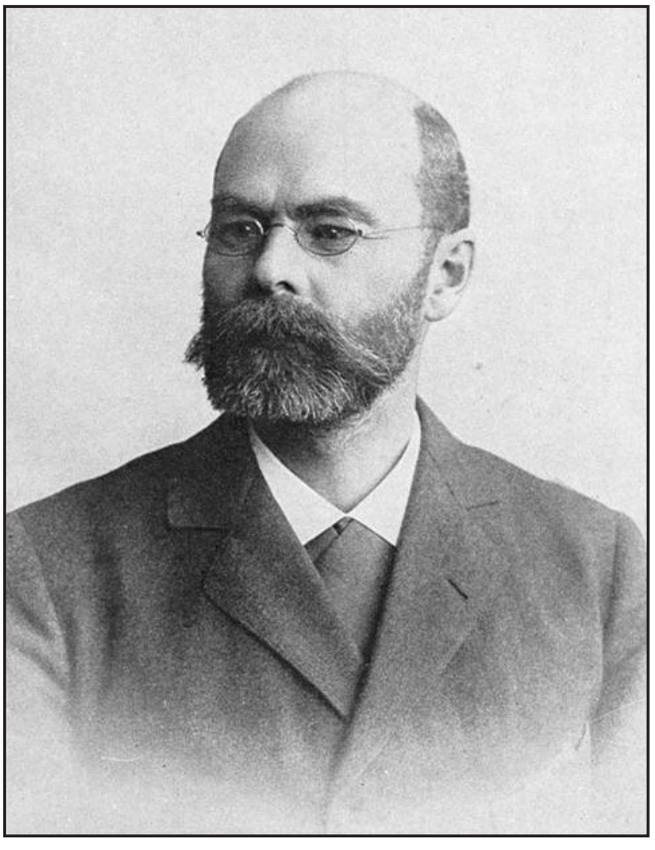
Gunneria 79

NTNU
Norwegian University of
Science and Technology
Museum of Natural History and Archaeology

Mikael Foslie.
His life and science

Edited by Eli Fremstad

Trondheim 2008



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Editorial preface

On 20 October 2005, the Royal Norwegian Society of Sciences and Letters, the Museum of Natural History and Archaeology, NTNU and the Gunnerus Library at NTNU hosted a symposium to commemorate the 150th anniversary of the birth of Mikael Foslie. This event coincided with the publication of a new catalogue of Foslie's coralline herbarium (Woelkerling & al. 2005) and a catalogue of letters he received from colleagues (Thor & al. 2005).

Foslie's research on coralline taxonomy had great international impact. The symposium aimed at covering Foslie's life and work in the context of the history of science. It also placed emphasis on how he influenced contemporary and modern research on coralline algae.

The efforts of Associate Professor Sigurd Mjøen Såstad were decisive for the preparation of the catalogue of Foslie's algal collection as well as the planning and arranging of the symposium. He also planned the present publication with symposium contributions. His death in July 2006 was unexpected and a great loss to the instiution. The editor regrets the delay of this volume of Gunneria.

The participants of the Foslie Symposium on 20 October 2005 outside the Gunnerus Building at the Museum of Natural History and Archaeology, Trondheim. Photo: Mentz Indergaard, NTNU.

1 Elisabeth Stur, 2 Kaare Aagaard, 3 Willem Prudhomme van Reine, 4 Eli Fremstad, 5 Jan Rueness, 6 Yngve Espmark, 7 Anne Kristine Børresen, 8 Harald Nissen, 9 Gunvor Foslie, 10 Torbjørn Ekrem, 11 Sigurd M. Såstad, 12 Michael Foslie, 13 Stein Johansen, 14 William J. Woelkerling, 15 Anders Lyngstad, 16 Tommy Prestø, 17 Liv S. Nilsen, 18 Sigmund Sivertsen, 19 Evelyn Thor, 20 Kjell Ivar Flatberg, 21 Gry Gustavsen.

Opening address

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Dear guests and colleagues, ladies and gentlemen!

It is an honour to welcome you all to this symposium. I do this on behalf of several organisers: the Royal Norwegian Society of Sciences and Letters, the Museum of Natural History and Archaeology and the Gunnerus Library. Welcome to all the scientists visiting us from Australia, the Netherlands and Oslo, members of the Foslie family, all the speakers and all the participants in the symposium!

We have been looking forward to this special symposium for a long time: Mikael Foslie – his life and science. A symposium on the occasion of the 150th anniversary of Mikael Foslie's birth

Mikael Foslie was, as we all know, a special person with a special career, and we will learn a lot more about that today. His life and work can also be studied in the two new catalogues and databases published on this occasion, one containing Foslie's coralline herbarium (Woelkerling & al. 2005), the other his interesting correspondence with colleagues (Thor & al. 2005). We are proud to present these catalogues today, and you will learn more about them later on. Let me mention that the museum, the library and a university project called Forum for the History of Knowledge have cooperated to fund their publication.

When Mikael Foslie was born back in 1855, higher education and a career as a scientist were very rare; something very few attained. Norway had ultimately achieved a University in 1811, but until 1857 there was still only one learned society in the country, the Royal Norwegian Society of Sciences and Letters here in Trondheim. As you know, this old society was founded as long ago as 1760 and still functions today, as an academy and a foundation. The society has had its ups and downs. In the first part of its history, it functioned as most learned societies, held meetings and debates, and built up a library and collections of items of different kind resulting in a museum. For a period in the 19th century, it functioned more like a foundation trying to help promising young scholars. We like to mention and are proud of our help to several people who later became famous scientists.

In the second part of the 19th century, the society developed into a research institution, working in the new buildings erected in the 1860s, the central buildings of the Museum today, where all the collections and the library could be both used and developed. In brief, the learned society started to develop into what is today the Museum of Natural History and Archaeology. In 1926, there was a new start for the more characteristic activities of a learned society, but both the museum and the library were part of the Royal Norwegian Society of Sciences and Letters up to 1984, when they formally became part of the University of Trondheim.

Mikael Foslie was appointed to a botany post in the Royal Norwegian Society of Sciences and Letters in 1892, and stayed here until his death in 1909. He became a member of the Society less than a year after his arrival in Trondheim, on 5 October 1892.

As you will understand, it is quite natural and of equal importance for the Royal Norwegian Society of Sciences and Letters, where he was one of our outstanding members, the Museum of Natural History and Archaeology, where he worked, and the Library, which he both used and helped to build up, to remember and honour Mikael Foslie. Mi-

kael Foslie is one of the people who has put the learned milieu in Trondheim on the map globally, and his scientific work is still of importance.

I want to thank those who have planned this symposium, and I am sure it will be an interesting one.

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Devoted to science. Research, society and family in the late nineteenth century

Anne Kristine Børresen

Abstract

Børresen, A.K. 2008. Devoted to science. Research, society and family in the late nineteenth century. – Gunneria 79: 9–15.

Foslie was a gifted amateur who became a leading coralline algae researcher. He followed an unusual route towards an academic career, but his career also shows important dimensions of Norwegian academic culture and the history of science in his time. In this article, Foslie's work is put into a wider perspective and some of the historical and scientific contexts of his environment are discussed. Hopefully, this can help to underline Foslie's special story and draw a clearer picture of the scientific environment in Norway during the late 19th and early 20th centuries.

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Introduction

The career of the Norwegian botanist and algae researcher Mikael Heggelund Foslie (1855–1909) puts an interesting perspective on the history of science in Norway in the late 19th and early 20th centuries.

Foslie was a gifted amateur who became a leading coralline algae researcher. He was born in Borge in Lofoten in 1855, on the coast of northern Norway. He no doubt attended the local school there. However, his parents probably had expectations for their son's education, or maybe a resourceful person close to his family spotted his talents. Whatever the reason, the young boy went to a private school organised by the vicar and later passed his lower secondary school examination in Tromsø (Wille 1911, Thor & al. 2005).

After that, Foslie was trained as a telegraphist, a profession he began practising in 1874, when he was 19 years old, during the annual fishery in the Lofoten Islands. Between 1876 and 1880, he was employed as a telegraphist in Lødingen. His interest in algae was triggered during the years in Lofoten and he started collecting various specimens (Holmboe 1929, Rueness 2001). During a visit to Kristiania, the Norwegian capital, in 1879, Foslie visited Frederik Christian Schübeler (1815–1892), a courageous and eccentric professor of botany at the University. This meeting would become important for Foslie's future career, not least because of Schübeler's keen interest in Foslie's collection.

The amateur was acknowledged by an authority in his field, which must have boosted the young telegraphist's self-confidence. Foslie impressed Schübeler, who from then on became a kind of mentor to Foslie and exerted a strong influence on his future development. New horizons were opened, and Foslie's life became increasingly devoted to algae research, and correspondingly less to his work as a telegraphist. For a while, he combined the two activities, but Schübeler encouraged him to join him in Kristiania, as Lofoten had no professional environment similar to that in Kristiania. Schübeler therefore helped Foslie to get a job as a telegraphist in the capital.

From 1880 to 1885, he combined his job as a telegraphist with spare-time studies at the Botanical Museum. Schübeler helped him to get access to the university's algal herbarium and academic literature.

Grants from the university gave Foslie the opportunity to study marine algae

in Finnmark, and this fieldwork led to the discovery of some new species and his first scientific paper, “on some new arctic ocean algae” (”Om nogle nye arktiske havalger”, Foslie 1881).

In 1886, at the age of 29, Foslie took up a position as an assistant curator at Tromsø Museum. From 1892 until he died in 1909, Foslie worked as a curator at the Museum of the Royal Norwegian Society for Sciences and Letters in Trondheim. Here he became an internationally recognised expert on algae.

Frederik Christian Schübeler was originally trained as a medical doctor (he obtained a professional degree in 1840). Having ended his education, he first worked as a doctor at the National Hospital in Oslo and subsequently started a private practice in Odalen and Lillesand. In 1848, he abandoned his medical career and, with a scholarship from the Royal Norwegian Society for Development, travelled across Europe to study botany and practical gardening. He won a university scholarship in botany in 1851, and the following year became curator at the Botanical Museum and head of experimental horticultural cultivation at the Botanical Garden at Tøyen (Oslo). He also worked as a lecturer in botany from 1864 and, after becoming a professor, was responsible for the Botanical Garden from 1866.

From amateur to an academic career

Clearly, Foslie followed an unusual route towards an academic career, but his career also shows important dimensions of Norwegian academic culture and the history of science in his time. In this article, I wish to put Foslie's work into a wider perspective and discuss some of the historical and scientific contexts of his environment. Hopefully, this can help to underline Foslie's special story and draw a clearer picture of the scientific environment in Norway during the late 19th and early 20th centuries.

Foslie was the amateur who became an internationally recognised research scientist. In other words, he was an ”outsider”. In contrast to most other contemporary scientists, he did not originate from the upper urban classes. Nor did he spend his early years anyway near the university. Moreover, he did not pass any formal examinations; yet he managed to attain a position as a researcher.

I have not been able to find any other Norwegian researchers who managed to rise to a similar position at that time. This does not necessarily mean that the professors and university teachers were originally educated in the subjects they lectured in. Many professors in the first half of the 19th century were educated in law, theology, medicine or mineralogy – studies which assured a job and a career (Collett 1999: 45–48). However, these studies could also be a starting point for a career in other disciplines at the university. The history of science in this period contains many examples of theologians who became scientists or historians, and medical doctors who became professors of biology, as was the case with Professor Schübeler. Even though university education was necessary to build an academic career, university training was still not strictly professionalised into disciplines.

The university until the end of the 19th century was by and large an elite institution for a narrow social stratum, as it had been since it was founded in 1811. The students were mostly recruited from the upper urban classes and the commercial bourgeoisie, and thus constituted a social and cultural aristocracy linked by family ties and cultural values. Their language and lifestyle were quite different from those of farmers and workers, but by the time Foslie entered the university this tradition was being challenged. The 1870s and –80s was a time of social transformation in Norway. Key political

and cultural changes began appearing, such as regarding who should govern the country, and young, rural people were acquiring a growing cultural awareness. These issues were manifested in society at large, but particularly within the university, and from the 1870s, sons of farmers became more common among the students.

Foslie therefore was by no means the only one from a non-urban upper class background. To the extent that Foslie socialised with his fellow students, he may have met kindred spirits who spoke and were clothed differently from sons from the upper class. Still, the time was not ripe for the rural students to obtain university positions. Instead they mostly became clerics and teachers. That Foslie had gained access to the university without formal education in the first place was quite special, even more that he could remain within academia the rest of his life.

His special path to an academic career says a lot about Foslie himself and his enthusiasm and capacity within his field. He acquired his knowledge alone, whereas his colleagues had studied for years at the university. For instance, Foslie was autodidact with respect to English. His particular academic career would of course not have been possible without the influence of Professor Schübeler and another botanist, Professor Johan Nordal Fischer Wille (1858–1924), who soon became aware of Foslie's knowledge and talents. At various times, these two professors would promote his academic career and help him to attain different positions.

It was not by accident that Foslie would spend most of his time as a researcher in museums. From the 1870s until World War I, the university in Kristiania, like universities in a number of western countries, underwent complex changes. It was transformed into a more research-oriented institution and the laboratory tended to replace the museum as the workshop of natural scientists. Moreover, independent research gradually emerged as a mandatory element in academic education. Compared to the research practice at the university, the museums in both Tromsø and Trondheim were more specialised units with a narrower focus. Their research was concentrated on the preservation, taxonomy and systematisation of the collections and in discussing their findings in correspondence with colleagues. The activities of the museums thus continued to concentrate on collections for quite some time after natural scientists at the university, from the 1850s onwards, linked their studies on collections to studies and experiments in the laboratory.

It was therefore not a coincidence that the museums attracted enthusiastic amateurs. This was, for instance, the case with Foslie's colleague, Ingebrigt Severin Hagen (1852–1917), a student of medicine, who after 30 years as a doctor devoted his life and studies to bryophytes at the museum in Trondheim (Holmboe 1931). The museum can be said to be an institution that was more open for a person like Foslie than the university, where the teachers from the late 19th century needed a degree to open the path to an academic career. Perhaps also the form of research in the museums, with its concentration on collections, suited Foslie, who was a man of practical skills and well known for his precision, diligence and working capacity, better than the more experimental culture at the university. The focus on collections suited Foslie. He won international recognition for his studies of calcareous algae. In the period 1887–1909, he published about 70 scientific papers, mainly on coralline algae. In line with the scientific ideals of the time, the papers were published in English or German. Already in 1895, he published a comprehensive study of the various types of calcareous algae in Norway, and during his career he received material from distant waters, some origi-

nating from large-scale scientific expeditions. Altogether he described 240 new species and about the same number of subspecies (cf. Woelkerling in this volume).

The specialist

Foslie was a specialist in algae and this was the only field he worked in. It seems to me that Foslie was a specialist at a time when most natural scientists could be considered generalists. University professors were admittedly linked to particular subject areas, but the boundaries between the disciplines were often blurred and university lecturers held classes and did research in a number of fields.

For example, Foslie's mentor, Professor Schübeler, published within a broad range of subjects. Johan H.L. Vogt (1858 –1932), a contemporary of Foslie, is another example. At the age of 27, Vogt attained a professorship in metallurgy at the University of Kristiania and most of his research centred on this subject. However, his entire academic production, amounting to about 200 papers, also included other topics within geology (Børresen 2004).

Most scientists at the time also wrote papers for a broader audience. For instance, Schübeler wrote popular articles on gardening in newspapers, magazines and journals, and in this way encouraged many gardening enthusiasts to put his theories and experiments into practice. Vogt also regularly wrote popular articles on useful rocks, minerals and metals, where these could be found and how they best could be exploited. These contributions were printed in publications like “Almanakken”, and subsequently reached a far broader audience than his scientific articles were able to.

Apparently Foslie did none of these things. According to N. Wille, this was because of his natural reserve and modesty. This may be partly true, but Foslie, with his background and unorthodox entry into the academic world, also lacked the natural self-confidence that many of the professors had, as they were trained for popularising scientific knowledge. Academic freedom was not in his reach to the same extent as it was for those who had pursued a traditional academic career.

The very first *Almanakk* was published in 1643 and it was in fact the first “book” printed in Norway. It has been published regularly since 1804. For a long time, it was the most important printed material, next to the Bible and the hymn book. The calendar and information on when the sun and moon rise at different places in Norway, tables of high and low tide along the Norwegian coast, holidays and old memorable days are among the most important information in the Almanakk.

Nevertheless, within his field, Foslie was in a class of his own. He frequently received requests from foreign researchers, who sent him samples they wished to have analysed and identified and they also joined him in writing scientific papers. Foslie developed into a key figure with great expertise in his field. This status was partially created through hard, painstaking work at the Museum in Trondheim, but also through his broad network with numerous researchers in his field after years of collaboration.

This network was to some degree a result of Foslie's extensive field trips. Before the turn of the century, he travelled to Sweden (1880, 1884, 1893, 1895, 1905), Denmark (1880), Finnmark in northern Norway (1880, 1881), England and France (1885–1886), the Netherlands (1892), England and Scotland (1892), England and Ireland (1899), as well as Amsterdam and Göttingen (1900 and 1901) to study his beloved algae. During these trips, Foslie got the opportunity to study calcareous algae himself, clearly an objective of his travels. In addition, by visiting researchers within the same field

as himself he could get a general view of their research activities, study their collections and carry out work in their laboratories.

Through extensive correspondence, Foslie managed to stay in touch with his contacts between his field trips. Several of them would send him samples they wished him to identify and which would be incorporated in his impressive collection.

In this respect, Foslie was hardly different from other scientists. Field trips and study abroad were common for researchers in the 19th century. For researchers in a peripheral country like Norway, with its small university and even smaller research units, sojourns at well-equipped and dedicated laboratories were even more necessary if they were to make progress. Accordingly, a large number of Norwegian scientists travelled abroad to link their own research with people and institutions elsewhere, thereby establishing professional networks they could rely on after returning home (Widmalm 2001: 34–77, Børresen 2001: 87–116).

For the individual researcher, these trips were crucial. Many returned home as more mature researchers with international publications on their CVs. In this way, the Norwegian scientific community received important impulses from leading research environments in Europe. Experience from abroad soon became a decisive criterion for recruitment to university positions. To obtain a permanent tenure, a long stay abroad would soon become a requirement. This particularly applied in science and medicine. It is fair to say that such travel helped to raise the scientific level.

The stays abroad also had impact beyond the individual researchers. The experience and personal contacts established during their time abroad would also benefit their colleagues and students at home. These travels would subsequently help to extend the research beyond national frontiers and emphasise the international aspect. The fact that most scientists also published their papers in German and gradually also in English, bolstered this tendency.

Foslie obviously was part of this dynamism. His correspondence (Thor & al. 2005) reflects how he used his network to obtain up-to-date information about chemicals for preparation, the latest techniques in microscopy and photography, and how to engage photographers and translators in his scientific production. He even started to publish papers in English in the Trondheim journal of the Royal Norwegian Society of Sciences and Letters (Det Kongelige Norske Videnskabers Selskabs Skrifter). Together with his growing international reputation, this helped to improve the status of this journal (Midbøe 1960: 44).

His foreign contacts and extensive correspondence with professional and amateur scientists throughout Europe, Australia, Asia and North America also enabled him to obtain coralline algae specimens from all over the world, either as gifts or in exchange for some of his own. His many contacts were thus instrumental in creating a rich and unique collection of algae from almost all corners of the Earth. This collection was essential for Foslie's further studies and also a basis for a growing number of scientific articles from his hand. In addition, the collection would benefit the Royal Norwegian Society of Sciences and Letters as Foslie's collection became famous world wide. Also after his death, the society received numerous requests to borrow specimens from Foslie's collection. The exchange and sale of duplicates also extended the Museum's collection. Together with the herbarium of Johan Ernst Gunnerus and Ingebrigt Severin Hagen's collection of mosses, Foslie's collection of algae became one of the Museum's most prestigious collections.

Foslie's collection of algae became important for demonstrating the Muse-

um's scientific standard. As the Museum at that time was also struggling to gain a foothold within scientific circles it became even more important. Since the beginning of the 19th century, the scientific work of the Royal Norwegian Society of Sciences and Letters had only been a modest part of the society's total activity. Its publications had dried up and the members were reduced to a clique among the city's economic and cultural elite. The new members produced little. However, from the end of the 18th century, the society gradually became responsible for a significant number of funds and awarded many prizes and scholarships, especially aiming to promote agriculture. Still, the society's meetings were seldom fruitful and it increasingly appeared as a scientific association without scientists. This may explain why, from 1874, the society began to devote more of its energy to the museum. The previous tendency to divide the membership into “classes” was ended. The same applied to the practice of electing members. Membership would be less based on scientific expertise and from 1903 anyone could become a member after paying a fee. This strategy transformed the society into a supportive association for the museum which, in addition to its ordinary functions, had also become an active research institute (Midbøe 1960). With his numerous publications, large network and impressive collection, Foslie helped significantly to strengthen the museum's research profile and its national and international reputation.

In contemporary documents, Foslie was presented as a particularly diligent and industrious researcher. His entry into science was unique and this did to some extent influence his practice. The fact that his work was specialised and that he did not approach the general public, made his practice different from most of the other scientists at the time.

His colleagues spoke of Foslie as an intelligent man who carefully and accurately put a lot of energy into his work. Science took almost all of his time. He really *devoted* himself to science. For those who knew him well and wrote his obituary, this explained why he managed to achieve so much.

The social context

There is certainly a lot of truth in these descriptions. One is impressed by the efforts and talents of 19th century researchers. In this article, I have tried to show that Foslie's work should not be considered as exclusively a result of his natural talent and practical skills, even though these are beyond dispute. Several aspects of Foslie's career, his working methods and practice fit into a larger pattern, which embraces most scientists of the 19th century. As already mentioned, Foslie was far from the only one to publish internationally in English or German. Networks of contacts were also a shared feature of the majority of his contemporary colleagues. Moreover, even though Foslie's collection of algae was impressive and favourable to the scientific reputation and status of the Royal Norwegian Society of Sciences and Letters, it was hardly unique in a Norwegian context.

That Foslie was able to devote himself entirely to his subject and profession was not unusual either. He lived at a time when men had ample opportunity to do just this. They spent long hours at work, only interrupted by a stroll home for dinner with their family before returning to their office or laboratory – if they did not withdraw to their study for correspondence or research. Sundays were devoted to their families, with whom they enjoyed hiking and receiving visitors. The summers were devoted to fieldwork and in Foslie's case his family was sent to Frosta, a rural area north of Trondheim, where Anna Foslie and the four children spent their holidays on their own.

Such a life would hardly have been possible without the consent of a family or an administrative apparatus, and this

backing existed in most cases. Anna Foslie, like the wives of other professors and researchers, was responsible for the household. Together with the ”maids” she took care of the house and the children; the domestic infrastructure was thus kept intact. The wives also willingly hosted friends and colleagues whom the researchers invited to social events. All this provided the father of the family with sufficient time for his science.

Sometimes Anne Foslie, like other wives, could contribute even more. She assisted Foslie in his work, wrote letters for her husband and maintained the contact between her husband and his colleagues when he was away at conferences, studies or doing fieldwork. As the children grew older, they could also step into the role of assistants to their father. The few female researchers of the time had to operate under the same conditions. It was therefore symptomatic that the country's first three female professors, Kristine Bonnevie (1872–1948, professor in 1912), Ellen Gleditsch (1879–1968, professor in 1929) and Helga Eng (1875–1966, professor in 1938), would remain unmarried. At that time, it was virtually impossible for women to combine an academic career and family life. They were almost mutually exclusive for female researchers, whilst an extra strength for a man.

In short, Foslie worked at a time when bonds between profession and family were strong. To achieve a greater understanding of his merits, we need to assess his professional activity within the context of his role as a family man.

Acknowledgements

I thank Evelyn Thor and Stein Johansen for sharing their material on Foslie with me and associate professor Lise Kvittingen at the Department of Chemistry for her comments on the article.

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The coralline red algal herbarium of Mikael Foslie and its impact on scientific research

William J. Woelkerling

Abstract

Woelkerling, W.J. 2008. The coralline red algal herbarium of Mikael Foslie and its impact on scientific research. – Gunneria 79: 16–35.

The non-geniculate coralline red algal (Corallinales, Rhodophyta) herbarium of Mikael Foslie and Foslie's publications have had and will continue to have a significant impact both on coralline red algal research and on our taxonomic understanding of these algae. The historical basis for Foslie's coralline research is briefly reviewed. Summary information on Foslie's herbarium and Foslie's contributions to coralline red algal taxonomy are followed by analyses of the subsequent impact both the herbarium and Foslie's publications have had on coralline taxonomy. Foslie described ten new genera and more non-geniculate coralline red species and infraspecific taxa than any other person. His 74 papers with information on the group include three major accounts of Norwegian and polar species and ten accounts of species from scientific expeditions and voyages to various parts of the globe. Foslie's herbarium remains extremely important as a taxonomic resource because over 450 type collections are present, because 556 species and infraspecific taxa are represented, and because his herbarium contains over 3000 voucher specimens that underpin published records of occurrence from all continents and from island groups in all oceans and major seas.

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The present paper originated from two presentations given by the author at the symposium.

Introduction

Mikael Foslie (1855–1909) was considered the world's leading authority on the taxonomy of non-geniculate coralline red algae (Corallinales, Rhodophyta) from about 1895 until his death in 1909. Foslie authored 74 papers dealing partly or entirely with corallines, and during his career, he amassed a herbarium that has become an essential resource for taxonomic and other work on coralline algae.

The broader scientific significance of coralline red algae already was widely appreciated during Foslie's lifetime. In the introduction to an account of the coralline red algae of the Siboga Expedition, Weber-van Bosse (1904: 1) wrote "No algae excited such general interest as calcareous algae. They are not only a delight and at the same time a constant puzzle to botanists, but also to geologists who are compelled to study them…". "Zoologists … … will fain to ask what these brilliant coloured organisms are, that are often found in such enormous masses in tropical, temperate, and arctic regions; either branched and forming knolls perhaps as big as or bigger than a man's fist, and giving shelter to innumerable animals; or crustlike, and covering corals, stones and other algae with thin or thick crusts".

The overall significance of corallines in current marine environments and in marine environments of the geological past has been further confirmed by considerable research during the past 100 years, and our understanding and

appreciation of that significance continues to increase during the 21st century.

The present paper provides a short account of the development of taxonomic knowledge of coralline algae prior to Foslie's work, summarizes Foslie's contributions, and considers the subsequent scientific impact of Foslie's research and of his coralline herbarium. An account of the basic features of coralline red algae and their ecological significance appears in A. Harvey & al. (2005: 14–50), while the most current classification system based on morphological and molecular data is in A. Harvey & al. (2003). A recent review of unattached corallines, commonly called rhodoliths, is provided by Foster (2001), while the most recent review of fossil coralline taxonomy is provided by Braga (2003). Somewhat older books and reviews dealing with corallines include those of Johansen (1974, 1976, 1981), Littler (1972), and Woelkerling (1988), all of which are now dated from a taxonomic point of view.

Historical basis for Foslie's coralline research

According to Irvine et al. (1994: 11), coralline algae first appeared in the historical record in "Historia Naturalis", a 37 volume work authored by Pliny the Elder (Gaius Plinius Secundus, AD 23–79). Harvey-Gibson (1919: 10) described "Historia Natruralis" as a 'hotch-potch of fact and fable', while Stearn (1983: 21) considered it 'a great storehouse of misinformation as well as of information, even more valuable as a collection of ancient errors than it is a repository of ancient science'. Pliny's work existed only in manuscript form until the appearance of the first printed edition in 1469 (Reed 1942: 42), published in Venice by Johannes de Spira.

The first person to use a binomial name for a coralline, namely *Corallina officinalis*, was Bauhin (1623: 363), who (Bauhin 1623) concurrently introduced the modern genus–species naming system for plants later adopted by Linnaeus (1753). Prior to the mid 1700's, many calcareous organisms, including coralline red algae, generally were treated as plants (e.g. see Imperato 1599, 1672, Bauhin 1623, Ray 1690, Sloane 1707). Ellis (1755: vii), however, had become convinced that coralline red algae were animals, and his close friend Linnaeus (1758) then classified all calcareous organisms, including corallines, as animals. The matter of whether coralline red algae were animals or plants subsequently was debated in the scientific literature until Philippi (1837), Kützing (1841), and Decaisne (1842a, b, c) provided definitive evidence that they were plants (algae) based in internal structure and on reproduction.

Johnston (1842), a British physician and naturalist who treated corallines as algae, divided them into two families, one (the Nulliporaceae, as Nulliporidæ) for species that were calcified throughout and one (the Corallinaceae, as Corallinadæ) for species with 'a branched articulated frond (composed of alternating calcified and non-calcified segments). Johnston (1842: 236), however, concluded that the 'nullipores' were not species but rather environmentally modified vegetative forms of the branched species *Corallina officinalis*.

The division of coralline red algae into two families also was proposed by the German phycologist Friedrich Kützing (1843, 1849). Kützing, who regarded all corallines to be true species, used the family names Spongitaceae (as Spongiteae) for taxa that were calcified throughout and Corallinaceae (as Corallineae) for taxa with branches composed of alternating calcified and non-calcified segments. Woelkerling (1988: 85–86) provides further information on family names. By contrast, the British phycologist William Harvey (1849) placed all coralline red algae in a single family, the Corallinaceae (as Ordo. Corallinaceae), and the single family concept was adopted by

the Swedish phycologist Johan Areschoug (1852) in his monographic account of the group. The single family concept subsequently predominated until 1993 (see Verheij 1993 and A. Harvey & al. 2003) and was always used by Foslie.

Areschoug's 1852 monograph was still a standard reference when Foslie first published on corallines in 1887. It was not, however, a comprehensive treatment of corallines described up to that time. Areschoug recognized 25 species of non-geniculate corallines and listed 20 others as species inquirendae (questionable species). At least 62 additional non-geniculate species and infraspecific taxa legitimately described before 1852 were not dealt with by Areschoug, however. Similarly, Areschoug recognized 50 species of geniculate corallines and listed 38 others as questionable species. At least 95 additional geniculate species and infraspecific taxa legitimately described before 1852 were not dealt with by Areschoug, however.

The first explicit Norwegian record of a coralline red alga appears to be that of Linnaeus (1767: 1285). Linnaeus incorrectly assigned his new name *Millepora polymorpha* to the species rather than using the earlier name *Millepora calcarea* (Pallas 1766: 163), which he listed as a synonym (see Irvine & Woelkerling 1986 and Woelkerling & Irvine 1986 for details). Based on Norwegian material, Gunnerus (1768: 71–73) concluded, however, that *M. polymorpha* was generically distinct from *Millepora*, and he placed it a new genus called *Apora* [as *Apora polymorpha* (Linnaeus) Gunnerus]. Gunnerus' name *Apora* was not taken up by subsequent researchers and now is a rejected name in favour of *Phymatolithon* (Irvine & Woelkerling 1986; Woelkerling & Irvine 1986). Gunnerus (1768, pl. 15) also was the first person to illustrate a Norwegian coralline. Both Linnaeus and Gunnerus considered corallines to be animals.

Only isolated records of coralline red algae occurring in Norway appeared in the literature over the next 100 years (Areschoug 1847, 1850a, b, Fries 1845, 1846). Norway was not explicitly mentioned in the world species compilation of Kützing (1849), and the only species explicitly reported from Norway in the monograph of Areschoug (1852: 557) was *Jania rubens* Linnaeus. This situation changed after 1870 with the publications of Areschoug (1875) and Kjellman (1879) on Scandinavian algae, of Kjellman (1875a, b, 1883, 1885) on algae from Spitsbergen and from the Arctic Sea (including northern Norway), and of Kleen (1874, 1875) on algae from northern Norway. By the time Foslie (1887: 175) first published on a coralline, 19 species and forms had been explicitly recorded from Norway (Table 1), but a comprehensive account of all corallines from the Norwegian coast had not been published (and never was published by Foslie). The most recent floristic treatment of Norwegian corallines is that of Rueness (1977: 56–63), while a summary of taxonomic and biogeographic literature relating to Scandinavian corallines is included in Athanasiadis (1996: 36–52).

Foslie's coralline herbarium

Foslie's studies were based on collections in his herbarium (including collections received from others) and to a lesser extent on collections he borrowed from and returned to other institutions or colleagues.

There are two structural groups of coralline red algae: one with branched or unbranched fronds composed of alternating calcified and non-calcified segments; and one in which calcification occurs throughout the vegetative thallus. Currently, the first group usually is termed geniculate (meaning jointed) while the second group usually is termed non-geniculate (meaning without joints). Foslie dealt much more extensively with non-

geniculate taxa, which he informally called 'lithothamnia' or 'melobesieae'.

Based on data in his herbarium (see Woelkerling & al. 2005), Foslie first collected a non-geniculate coralline in 1876, at the age of 21, two years after he became a telegraphist in northern Norway. Foslie actively continued to collect non-geniculate corallines until August 1908. After a period of study in Oslo, and of work in the telegraphic service in Oslo, Foslie was appointed as a Curator at the Tromsø Museum, and he took up the position on 1 July 1885 with a salary of 2000 kroner (Vorren 1972: 50). He then moved to a similar position at Det Kongelige Norske Videnskabers Selskab Museet (Royal Norwegian Society of Sciences and Letters) in Trondheim in January 1892, also with a salary of 2000 kroner (Thor & al. 2005: 40, entry 204).

Foslie brought his herbarium to Trondheim in 1892. In 1896, however, the Royal Norwegian Society of Sciences and Letters bought the entire herbarium (including non-coralline algae and other plants) for 3700 kroner (Rygh & al. 1897: IV), nearly twice Foslie's annual salary. In the same year, the Society expenditure for the library was 3432.31 kroner (Rygh & al. 1897: VII), and this suggests that Foslie's herbarium was a major purchase and scientific investment for the Society. The July 2005 equivalent of 3700 kroner is 223 752.63 kroner (information supplied by Gry Gustavsen).

Data from Foslie's herbarium shows that at the end of 1896, it contained 416 non-geniculate coralline collections from Norway, of which 253 were collected by Foslie. Four hundred sixteen collections represents only about 11% of all non-geniculate corallines in Foslie's herbarium and is evidence that most non-geniculate coralline collections were obtained after 1896 when the Society owned the herbarium.

Woelkerling & al. (2005) provide an analytical account of Foslie's main coralline herbarium as well as a complete list of collections. According to Woelkerling & al. (2005), Foslie's herbarium contains 3880 collections, over 80% of which were obtained from other institutions or colleagues. Foslie's herbarium also contains material from 38 scientific expeditions and voyages.

During his lifetime, Foslie gathered 596 non-geniculate scoralline collections: 533 from Norway, 60 from Ireland, 2 from the United Kingdom, and 1 from an unspecified nation. Table 2 contains a summary of the number of Norwegian collections made by Foslie on a yearly basis during 1876–1908. Table 2 also includes a summary of the number of papers with coralline information and authored by Foslie during each year from 1887–1909 (–1912).

At least 265 other collectors are represented by material in Foslie's coralline herbarium, of which the following are represented by 40 or more collections: F. Børgesen (86 collections), F. Debray (70 collections), A. Engelhart (51 collections), J. Gabriel (60 collections), J. Gardiner (95 collections), M.A. Howe (232 collections), H. Jónsson (44 collections), E.H.P. Kuckuck (214 collections), E. Norum (42 collections), L.K. Rosenvinge (73 collections), C. Sauvageau (88 collections), W.A. Setchell (40 collections), A. Weber-van Bosse (220 collections), J.N.F. Wille (53 collections), and K. Yendo (76 collections). Biographic notes on all collectors represented in Foslie's herbarium are included in Woelkerling & al. (2005: 592–607).

Foslie's herbarium contains 556 species and infraspecific taxa, of which 464 are represented by type material. The herbarium includes collections from 118 geographic regions (Woelkerling & al. 2005: 608–614), of which the following are represented by 50 or more collections (number of collections listed in parenthesis): Algeria (63), Australia (155), Bahamas (75), Canada (77), Croatia (216), Denmark (73), France (253), Greenland (55), Iceland (66), Indonesia (209),

Table 1. Published records of coralline algae from Norway (including Svalbard) up to and including 1887, the date of Foslie's first paper containing information on these algae. Taxa listed alphabetically by final epithet. Records within each taxon listed chronologically.

aliciorne
Lithothamnion aliciorne Kjellman. Kjellman 1883: 121, pl. 5, figs 1–8. Kjellman 1885: 91.

calcareum
Lithothamnion calcareum Kjellman. Kjellman 1875a: 64.

fasciculatum
Lithothamnion fasciculatum (Lamarck) Areschoug. Kleen 1874: 11. Kjellman 1875b: 3. Areschoug 1875: 5. Kleen 1875: 11.

flavescens
Lithothamnion flavescens Kjellman. Kjellman 1883: 129, pl. 6, figs 1–7. Kjellman 1885: 98, pl. 6, figs 1–7.

glaciale
Lithothamnion glaciale Kjellman. Kjellman 1883: 123, pl. 2–3. Kjellman 1885: 93, pp. 2–3. Strömfelt 1886: Table between pp. 16–17. Strömfelt 1887: Table between pp. 16–17.

intermedium
Lithothamnion intermedium Kjellman. Kjellman 1883: 127, pl. 4. Kjellman 1885: 97. Strömfelt 1886: Table between pp. 16–17. Strömfelt 1887: Table between pp. 16–17.

lejolisii
Melobesia lejolisii Rosanoff. Kjellman 1883: 137 (with a question mark). Kjellman 1885: 105 (with a question mark).

lenormandii
Melobesia lenormandii Areschoug. Kleen 1874: 11. Areschoug 1875: 1. Kleen 1875: 11.
Lithophyllum lenormandii (Areschoug) Rosanoff. Kjellman 1883: 136. Kjellman 1885: 103.

macrocarpa
Melobesia macrocarpa Rosanoff. Kleen 1874: 11. Kleen 1875: 11. Kjellman 1883: 137. Kjellman 1885: 105. Strömfelt 1886: Table between pp. 16–17. Strömfelt 1887: Table between pp. 16–17.

membranacea
Melobesia membranacea (Esper) Lamouroux. Fries 1845: 126. Fries 1846: 126. Areschoug 1847: 289. Areschoug 1850b: 67. Kleen 1874: 11. Kleen 1875: 11. Kjellman 1883: 137. Kjellman 1885: 104.

norvegicum
Lithothamnion calcareum var. *norvegicum* Areschoug. Areschoug 1875: 4 (also uses the name f. *norvegicum* on p. 5).
Lithothamnion norvegicum (Areschoug) Kjellman. Kjellman 1883: 122, pl. 5, figs 9–10. Kjellman 1885: 93, pl. 5, figs 9–10.

officinalis
Corallina officinalis Linnaeus. Areschoug 1847: 287. Areschoug 1850b: 65. Kleen 1874: 11. Kleen 1875: 11. Kjellman 1883: 116. Kjellman 1885: 86. Strömfelt 1886: Table between pp. 16–17. Strömfelt 1887: Table between pp. 16–17.

officinalis* f. *flexilis
Corallina officinalis f. *flexilis* Kjellman. Kjellman 1883: 114, 116. Kjellman 1885: 86.

officinalis* f. *robusta
Corallina officinalis f. *robusta* Kjellman. Kjellman 1883: 114, 116. Kjellman 1885: 86.

polymorphum
Millepora polymorpha Linnaeus. Linnaeus 1767: 1285.
Apora polymorpha Gunnerus. Gunnerus 1768: 71, pl. 15, figs 1–3.
Lithothamnion polymorphum (Linnaeus) Areschoug. Kleen 1874: 11. Areschoug 1875: 5. Kleen 1875: 11. Kjellman 1883: 134. Kjellman 1885: 102. Strömfelt 1886: Table between pp. 16-17. Strömfelt 1887: Table between pp. 16–17.

pustulata
Melobesia pustulata Lamouroux.. Areschoug 1847: 287. Areschoug 1850b: 65. Areschoug 1875:3

rubens
Corallina rubens Linnaeus. Areschoug 1847: 288. Areschoug 1850b: 66.
Jania rubens (Linnaeus) Lamouroux. Fries 1845: 126. Areschoug 1852: 557.

soriferum
Lithothamnion soriferum Kjellman. Kjellman 1883: 117, 120, pl. 1. Kjellman 1885: 88. Strömfelt 1886: Table between pp. 16–17. Strömfelt 1887: Table between pp. 16–17.

ungeri
Lithothamnion ungeri Kjellman. Kjellman 1883: 120. Kjellman 1885: 91.

Table 2. Number of TRH coralline collections from Norway with Foslie listed as collector and number of papers authored by Foslie that contain coralline red algal information. Table derived from data in Woelkerling & al. (2005).

Year	Number of collections with Foslie as collector	Foslie collections: cumulative total	Number of papers with coralline data authored by Foslie	Number of coralline papers: cumulative total
1876	1	**1**	0	**0**
1877	0	**1**	0	**0**
1878	0	**1**	0	**0**
1879	0	**1**	0	**0**
1880	0	**1**	0	**0**
1881	9	**10**	0	**0**
1882	38	**48**	0	**0**
1883	1	**49**	0	**0**
1884	3	**52**	0	**0**
1885	2	**54**	0	**0**
1886	2	**56**	0	**0**
1887	13	**69**	1	**1**
1888	0	**69**	0	**1**
1889	2	**71**	0	**1**
1890	50	**121**	1	**2**
1891	23	**144**	1	**3**
1892	12	**156**	2	**5**
1893	4	**160**	0	**5**
1894	67	**227**	1	**6**
1895	9	**236**	2	**8**
1896	17	**253**	0	**8**
1897	167	**420**	3	**11**
1898	13	**433**	4	**15**
1899	5	**438**	5	**20**
1900	0	**438**	10	**30**
1901	0	**438**	6	**36**
1902	27	**465**	2	**38**
1903	10	**475**	3	**41**
1904	6	**481**	4	**45**
1905	26	**507**	6	**51**
1906	9	**516**	4	**55**
1907	1	**517**	8	**63**
1908	9	**526**	7	**70**
1909	0	**526**	3	**73**
1912	0	**526**	1	**74**
No date	3	**529**		
1882 & 1884	1	**530**		
1882 & 1887	3	**533**		
Total	533		74	

Jamaica (55), Japan (78), Norway (916), Puerto Rico (65), Ireland (129), Sweden (61), United Kingdom (101), United States (194), and the U.S. Virgin Islands (67). Norway accounts for 23.6% of the 3880 non-geniculate collections in Foslie's herbarium, while the above 19 regions collectively account for 74.9% of the non-geniculate collections in the herbarium.

Foslie's contributions to coralline red algal taxonomy

Foslie's contributions to the taxonomy of geniculate corallines were extremely limited. Foslie (1887: 175) described only one new geniculate coralline: *Corallina hemisphaerica*, which he (Foslie 1893: IX) later reduced to a form of *C. officinalis* (*C. officinalis* f. *hemisphaerica*). Foslie (1890: 5–6) also provided a short account of *C. officinalis* in his study of the marine algae of East Finnmark but did not mention *C. hemisphaerica*. Geniculate coralline species were not dealt with in detail by Foslie after 1890, although incidental mentions occur in a few papers.

Foslie first published on non-geniculate corallines in an account of the marine algae of East Finnmark (Foslie 1890). In 1882, however, Foslie sent a number of non-geniculate collections from northern Norway to the Swedish phycologist F.R. Kjellman in Uppsala, who was preparing a monograph of arctic algae. Foslie had collected the material during field trips to East Finnmark in 1881 and 1882, and Kjellman (1883: 120, 122, 129, 135; 1885: 91, 92, 98, 103) acknowledged Foslie's contributions to his account. Of the 18 coralline taxa recorded by Kjellman (1883, 1885), 14 were reported to occur in northern Norway, and six involved material sent by Foslie.

Foslie (1890) recorded 15 species and forms from East Finnmark. Twelve (*Corallina officinalis* Linnaeus, *C. officinalis* f. *flexilis* Kjellman, *C. officinalis* f. *robusta* Kjellman, *Lithophyllum lenormandii* (Areschoug) Rosanoff, *Lithothamnion flavescens* Kjellman, *L. glaciale* Kjellman, *L. intermedium* Kjellman, *L. norvegicum* (Areschoug) Kjellman, *L. polymorphum* (Linnaeus) Areschoug, *L. soriferum* Kjellman, *L. ungeri* Kjellman, *Melobesia macrocarpa* Rosanoff) had been reported previously by Kjellman (1883, 1885), two (*Lithothamnion circumscriptum* Strömfelt, *Lithophyllum leave* Strömfelt) had been described by Strömfelt (1886, 1887) from Iceland and were newly recorded from Norway by Foslie, and one (*Lithophyllum zonatum*) was a newly described species. It is unclear why two species (*Lithothamnion alcicorne* Kjellman, *Melobesia membranacea* (Esper) Lamouroux) reported from northern Norway by Kjellman (1883, 1885) were not also mentioned by Foslie (1890).

Prior to 1890, Foslie had gathered 71 collections of corallines from Norway (Table 2). Fifty additional Norwegian collections were gathered by Foslie during 1890, and together, these formed the basis for the description of eight new species and forms (*Lithothamnion boreale* Foslie, *L. colliculosum* Foslie, *L. fornicatum* Foslie, *L. intermedium* f. *nana* Foslie, *L. norvegicum* f. *distans* Foslie, *L. norvegicum* f. *globulata* Foslie, *L. soriferum* f. *divaricata* Foslie, *L. soriferum* f. *globosa* Foslie) in a paper published in the following year (Foslie 1891). Foslie (1891) also reduced *Lithothamnion alcicorne* Kjellman to a form of *L. soriferum* [*Litho-thamnion soriferum* f. *alcicorne* (Kjellman) Foslie] and reduced *Lithophyllum laeve* Strömfelt to a form of *L. lenormandii* [*Lithophyllum lenormandii* f. *laeve* (Strömfelt) Foslie]. The pattern of describing new taxa of non-geniculate corallines and changing the status of others was established in this paper and prevailed in subsequent Foslie publications on the group.

Four years later, Foslie (1895) published a major monograph dealing with the Norwegian taxa of *Lithothamnion*. It was the largest paper Foslie ever wrote on non-geniculate corallines. Fifty-five new species and infraspecific taxa were described (see list in Woelkerling 1993:

254 –256), the genus *Lithophyllum* was reduced to a subgenus of *Lithothamnion*, the subgenus *Lithothamnion* was divided into two newly described Sections (Sectio Innatae, Sectio Evinidae), some brief comments were provided on fossil species, and the text was accompanied by 23 photographic plates. Foslie (1895: 38–39) also acknowledged receipt of specimens from a number of colleagues, who were coming to consider Foslie as an authority on non-geniculate corallines. Unfortunately, Foslie did not provide keys for taxon identification. Nevertheless, this publication constituted the most significant account of non-geniculate corallines since the monograph of Areschoug (1852). The 1895 monograph brought Foslie almost immediate worldwide recognition as the expert on non-geniculate corallines.

Foslie soon became involved in identifying and describing non-geniculate corallines sent to him from many geographic regions (see Woelkerling et al. 2005: 608–614), and the number of nongeniculate coralline collections in his herbarium rapidly grew. Moreover, the number of papers containing information on the group authored by Foslie rose from 8 at the end of 1895 to 73 at the time of his death in 1909, and one further paper appeared posthumously (Foslie 1912).

In addition to the floristic account of East Finnmark (Foslie 1890) and the 1895 monograph, Foslie (1905a) produced one other major paper dealing with non-geniculate corallines from arctic and subarctic regions. A number of species and forms he had described in previous publications were placed in the synonymy of other taxa in the 1905 paper, but Foslie also described 23 new species and infraspecific taxa. This paper also did not include any illustrations, nor were taxonomic keys provided.

All of Foslie' publications on non-geniculate corallines were taxonomic. In addition to the three monographic accounts already mentioned, he authored separate accounts of non-geniculate corallines from 10 scientific voyages and expeditions, produced six papers in a series entitled "Algologiske notiser", wrote a series of annual reports for the Museum under the title "Den botaniske samling", and published a series of other papers all concerned with describing new taxa and changing the status of others. Many papers in the last group were short, and several dealt with only one or two species. Foslie also contributed information on corallines to at least 16 publications written by other authors. A complete list appears in Woelkerling et al. (2005: 570–579).

Throughout this career, Foslie placed all coralline red algae in a single family, the Corallinaceae. Foslie (1903: 25) once suggested dividing the family into eight groups (Table 3), but he did not assign the groups to a formal taxonomic rank. Subsequently Svedelius (1911: 264) equated Foslie's groups with the taxonomic rank of Tribe (a secondary rank between Subfamily and Genus). Foslie placed all geniculate genera in one group, which he called the Corallineae. Non-geniculate genera were distributed amongst six groups (Chaetolithoneae, Lithothamnieae, Schmitziellae, Choreonemeae, Melobesieae, Mastophoreae), but Foslie did not indicate how the groups were delimited from one another. Foslie also suggested with a question mark (indicating uncertainty) the inclusion of an eighth group, the Hildenbrandieae, containing the genus *Hildenbrandia*. Currently, morphological and molecular evidence (A. Harvey & al. 2003) supports recognition of three families within the Order Corallinales: the Corallinaceae (containing four subfamilies), the Hapalidiaceae (containing three subfamilies), and the Sporolithaceae (not currently divided into subfamilies). *Hildenbrandia* now is referred to a separate Order, the Hildenbrandiales (Pueschel & Cole 1982, Irvine & Pueschel 1994, Saunders & Kraft 1997, Harper & Saunders 2001).

Foslie described ten new genera of non-geniculate corallines: *Chaetolithon* (Foslie 1898b: 7), *Clathromorphum* (Foslie 1898a: 4), *Dermatolithon* (Foslie 1898b: 11), *Goniolithon* (Foslie 1898b: 5), *Heteroderma* (Foslie 1909: 56), *Hydrolithon* (Foslie 1909: 55), *Litholepis* (Foslie 1905b: 5), *Lithoporella* (Foslie 1909: 58), *Phymatolithon* (Foslie 1898a: 4), and *Porolithon* (Foslie 1909: 57). Four names (*Clathromorphum*, *Hydrolithon*, *Lithoporella*, *Phymatolithon*) remain in use today (see A. Harvey & al. 2003: 995); five others (*Chaetolithon*, *Dermatolithon*, *Heteroderma*, *Litholepis*, *Porolithon*) are generally considered to be heterotypic synonyms; and the status of *Goniolithon* remains unresolved (see Woelkerling 1988: 216–217). Within some genera, Foslie (e.g. 1898a, 1900, 1904, 1905b, 1909) also proposed various subgenera and sections (for details, see Woelkerling 1988: 91, 103–104, 127, 131, 141–142, 149, 163, 173, 175, 199, 217, 221), but these were not widely adopted and now also are mainly of historical interest.

Prior to 1891, approximately 180 species and infraspecific taxa of non-geniculate corallines had been described (Woelkerling unpublished data). Between 1890 and 1910, when Foslie worked, an additional 553 taxa were described, and over 75% of these were established by Foslie. Woelkerling (1993: 7) stated that Foslie legitimately established 428 new species and infraspecific taxa of coralline red algae, and also published 80 other superfluous substitute names, nomina nuda, provisional names and later homonyms. A chronological list of Foslie's names has been provided by Woelkerling (1993: 254–270), while an index to the taxa mentioned in Foslie's publications is contained in Woelkerling (1984).

At the time of his death in 1909, Foslie was in the early stages of producing a world monograph of non-geniculate corallines. According to Printz (1929: 5), Foslie had completed 30 photographic plates but only had produced scattered notes relating to the planned text. Printz (1929) subsequently prepared another 45 plates using specimens from Foslie's herbarium, and Printz also wrote a text that included keys, a historical survey, notes on coralline morphology and anatomy, and a biographic sketch of Foslie.

Subsequent impact of Foslie's coralline herbarium

The scientific impact of Foslie's coralline herbarium is substantial and ongoing. As a taxonomic resource, Foslie's herbarium constitutes an international scientific treasure under the permanent care of the NTNU Museum of Natural History and Archaeology (herbarium TRH).

One important factor in making Foslie's herbarium so valuable scientifically is the occurrence of hundreds of type collections. Type specimens are reference points for the correct application of scientific names to organisms. Without types, the use of names would become chaotic and untrustworthy, and it would become impossible to have confidence in any taxonomic work or in any other work in which species names are used. Moreover, the study of types is an essential part of taxonomic research. The "International Code of Botanical Nomenclature" specifies that each species or infraspecific specimen must have a type specimen, and the Code provides guidance for designating or selecting types.

Woelkerling & al. (2005: 13–14) have determined that type material of 465 species and infraspecific taxa of non-geniculate corallines occur in Foslie's herbarium and thus that 83% of the 556 taxa in Foslie's herbarium include type material. Woelkerling & al. (2005) also have noted that 70 more non-geniculate coralline species and infraspecific taxa are represented by type material in Foslie's herbarium than in the Muséum national d'Histoire naturelle (herbarium PC**:** 184, according to Woelkerling 1998c: 393),

Table 3. Groups of Corallinaceae proposed by Foslie (1903: 25). Foslie gave the groups names but did not assign a taxonomic rank, did not provide descriptions and did not indicate how the groups were delimited from one another. Some genera included by Foslie are no longer recognized, some genera widely recognized at that time (e.g. *Jania*) were not mentioned, and the concepts of most genera included by Foslie have since changed.

Group Chaetolithoneae
Included genus: *Chaetolithon*
Group Choreonemeae
Included genus: *Choreonema*
Group Lithothamnioneae
Included genera: *Archaeolithothamnion*, *Clathromorphum*, *Lithothamnion*, *Phymatolithon*
Group Mastophoreae
Included genus: *Mastophora*
Group Melobesieae
Included genera: *Dermatolithon*, *Goniolithon*, *Lithophyllum*, *Melobesia*
Group Schmitzielleae
Included genus: *Schmitziella*
Group (Hildenbrandieae)
Included genus: *(Hildenbrandia* ?)
Group Corallineae
Included genera: *Amphiroa*, *Cheilosporum*, *Corallina*

the Nationaal Herbarium Nederland Unieriteit branch, Leiden (L: 114, according to Woelkerling & Verheij 1995: 83) and the Natural History Museum (London) (BM: 96 determined from data in Tittley & al. 1984) combined.

The presence of so many type colections alone makes Foslie's herbarium a permanent, essential resource for taxoomic research on these algae.

A second important factor in making Foslie's herbarium so valuable is the occurrence of over 3000 voucher collections. Voucher collections underpin the published records of species and infraspecific taxa. Anyone wanting to verify past published records for a species from a particular region needs to re-examine the collections upon which the records are based. By examining vouchers, past published records can be confirmed or updated or discounted. Foslie published extensively on collections from all continents and from many island groups in all oceans, and he recorded many species and infraspecific taxa. The collections underpinning Foslie's published records are in his herbarium, and the verification of his records can only be established through re-examination of relevant voucher material. Because of the high standard of curation of material in Foslie's herbarium, type collection determination and examination as well as voucher verification have been able to be conducted by many subsequent authors.

Foslie rarely designated type collections in publication, and virtually none of the collections in his herbarium were marked as type material at the time of Foslie's death in 1909. The task of identifying or designating type collections in his herbarium has been done by others, mostly since 1960.

Since 1960, four major publications dealing directly with the Foslie herbarium have appeared. The first is the "Catalog of The Foslie Herbarium" (Adey & Lebednik 1967) who prepared their catalogue "…to make the collection more acces-

sible to phycologists" and to "…help reawaken interest in the taxonomic and ecologic problems presented by the crustose corallines". They flagged a number of type collections and also anticipated (p. 2) that any errors present in their publication would be corrected in a future version.

The second major publication dealing directly with the Foslie herbarium after 1960 is "A Revision of the Foslie Crustose Coralline Herbarium" (Adey 1970), which listed or designated types for 233 taxa in Foslie's herbarium and placed them in various genera as they were understood at that time. Adey (1970: 1) noted, however, that many descriptions of non-geniculate corallines from Foslie's time "…are quite inadequate by modern standards". Adey (1970: 2) also noted that with few exceptions, only species types were dealt with his 1970 study and were flagged in the catalogue publication (Adey & Lebednik 1967). However, types of some species considered synonymous of others or reduced to the rank of form by Foslie were deliberately excluded (Adey 1970: 2), and the types of infraspecific taxa were not dealt with unless they were later raised to and retained in the rank of species.

The third major publication dealing directly with the Foslie herbarium is "Type Collections of Corallinales (Rhodophyta) in the Foslie Herbarium (TRH)" (Woelkerling 1993). This publication presented information on 490 type collections in the Foslie herbarium, including those for taxa described by authors other than Foslie (Woelkerling 1993: 271–273). It also contained information on 80 names used by Foslie that are contrary to the rules of the International Code of Botanical Nomenclature. Woelkerling (1993: 254–270) provided a chronological list of taxa described by Foslie.

The fourth major publication dealing directly with the Foslie herbarium after 1960 is "The Coralline Red Algal Herbarium of Mikael Foslie: Revised Catalogue with Analyses" (Woelkerling & al. 2005). The types of all species and infraspecific taxa are identified, and all collections are listed individually. In Adey & Lebednik (1967), by contrast, less than half the types present were flagged and multiple collections were sometimes grouped under single entries.

As a prelude to publication of the revised catalogue (Woelkerling & al. 2005), all collections in Foslie's coralline herbarium have been given official herbarium numbers to facilitate precise collection identification and to facilitate citation in publication. The collections were not yet numbered when Adey & Lebednik (1967) prepared the original catalogue. The revised catalogue also contains a summary analysis of material in the herbarium, listings of collections in the Ancillary Coralline Herbarium of Foslie and the exsiccata set prepared from Foslie specimens (Gjærevoll 1950), and four Appendices that respectively contain a list of all Foslie publications, sources of collections in Foslie's herbarium, biographic notes on collectors and communications of specimens in Foslie's herbarium, and data on the geographic regions from which specimens came.

Subsequent impact of Foslie's coralline research

The application of taxonomic names is governed by rules contained in the "International Code of Botanical Nomenclature". Amongst other things, the Code specifies that a given taxon can have only one correct name: the oldest available name that is in accord with the Code. Foslie coined 508 species and infraspecific names for corallines, of which 428 are legitimate in the context of the Code. Thus, of the 736 species and infraspecific names of nongeniculate corallines published up to 1910, Foslie established 428 or roughly 58%. This has had an enormous impact on subsequent taxonomic work on non-geniculate corallines because of the ongoing need to deter-

mine which names are correct in the context of modern understanding of species and their delimitation.

Foslie faced many challenges in describing and delimiting species and infraspecific taxa. Foslie (1895: 29, 30) noted, for example, that the limits between species were not easily drawn and that forms could vary within wide limits. Nevertheless, Foslie based many taxa on apparent differences in external morphology or apparent differences in conceptacle shape and size. Ten years later, Foslie (1905a: 3, 4) concluded that he had placed too much emphasis on conceptacle shape and size, and he noted (Foslie 1905a: 9) that external morphology was often influenced by habitat and environmental factors. While he reduced some taxa to synonymy, he continued to describe many others during the years from 1905 to 1909 (Woelkerling 1984: 11 [Table 3]; Woelkerling 1993: 254–270 [Table 9]).

In an analysis of Foslie's publications, Woelkerling (1984: 7–18) found that Foslie never provided keys or tables that summarized the distinguishing features of his taxa, seldom provided illustrations, frequently and rapidly changed his mind on the status and limits of taxa, and commonly described new taxa from isolated specimens, some of which were stated by Foslie to be sterile or fragmentary. Woelkerling (1984: 17) concluded that by modern standards "… Foslie's concepts of species and infraspecific taxa are often vague and superficial, are extremely difficult to evaluate, and are surrounded by many uncertainties, confusing accounts, and changes of mind".

It is most fortunate that Foslie's collections have remained available for subsequent study. Concepts of species and genera have changed substantially since the time of Foslie, and this means that the types and vouchers require reassessment in a current context. Such reassessments are ongoing and will continue into the future.

Based on recent studies (e.g. Alongi & al. 2002, Cabioch & Mendoza 1998, Chamberlain & Keats 1995, Keats & Chamberlain 1997, Mateo-Cid & Pedroche 2004, Riosmena-Rodriguez & al. 1999, Townsend & al. 1995, Verheij 1993, Woelkerling & Harvey 1993) involving type material in Foslie's herbarium, researchers have determined that some names introduced by Foslie are correctly applied to species as currently understood, while some other Foslie names have been determined to be later synonyms or of uncertain status. The types of most names introduced by Foslie, however, have yet to be reassessed in a modern context.

The increasing use of molecular data in taxonomic research makes the Foslie herbarium even more important. Most of the specimens in Foslie's herbarium were air-dried and thus potentially can provide significant, new molecular data. The selection of Foslie herbarium material for molecular analyses, however, must be done with caution to avoid inadvertently using mixtures of species that occur in some collections (see listings in Woelkerling & al. 2005, Chapter 4 for some known examples) and to ensure material is correctly identified in a modern context.

The true species biodiversity of coralline red algae on a global scale remains uncertain. What is certain, however, is that coralline red algae are common and often conspicuous components of benthic communities from tropical to polar latitudes in all of the world's oceans, that they provide habitat, refuge and grazing areas for many fish and invertebrates, that they act as settlement inducers for the larvae of many marine invertebrates including species of economic importance, and that they are of fundamental importance in the growth and maintenance of coral reef ecosystems. Harvey & al. (2005: 14–16) provide examples and references. What also is certain is that taxonomic research underpins the

correct application of names and that reliable use of names in ecological and other research work is essential to the scientific process. Further comments on the fundamental importance of good taxonomic research in the pursuit of other biological research are provided in "Understanding Marine Biodiversity", authored by the Committee on Biological Diversity in Marine systems (1995).

Foslie's publications and his herbarium will continue to be a vital resource for research on non-geniculate corallines. There is no doubt that Foslie's herbarium is and will remain an international scientific treasure. In terms of non-geniculate coralline taxonomy and phylogeny, all roads lead to Foslie's herbarium at the Museum of Natural History and Archaeology in Trondheim.

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Anna Weber-van Bosse and her relation to Mikael Foslie

Willem Prudhomme van Reine

Abstract

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Anna Weber-van Bosse had a special relation with Mikael Foslie. Not only because he helped her in her studies of coralline algae collected by the Siboga Expedition, but also because of their joint antipathy towards the German phycologist Franz Heydrich. Mainly based on data in letters from Mikael to Anna (in the National Herbarium of The Netherlands, University of Leiden Branch) and from Anna to Mikael (in the Gunnerus Library in Trondheim), the contact between these two important phycologists is investigated and a few anecdotes are highlighted. Connections with some other phycologists, as well as normal social relations between international scientists, are discussed, resulting in a plea for peer-reviewed publishing.

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Introduction

When I was the curator of the algal collections at the National Herbarium of The Netherlands, University of Leiden Branch (formerly the National Herbarium), one of our distinguished guests was Professor W.J. Woelkerling, who was most interested in our collections and especially in the coralline algae therein. He found many very interesting collections in our herbarium, including the Corallinaceae of R.A. Philippi and the Siboga Expedition material studied by Mikael Foslie. He also discovered, in our phycological library, a considerable number of letters from Mikael Foslie to Anna Weber-van Bosse (Fig. 1). Apart from these 58 letters by Mikael to Anna Weber-van Bosse I have seen copies (from the collection of botanical letters to Mikael H. Foslie in the Gunnerus Library in Trondheim) of the most important of the 112 letters from Anna (Fig. 2; see also the front page of Gunneria 77) to Mikael and of one letter (of the eight in the Gunnerus Library) written by Max Weber, Anna's husband. The handwritings of both Anna and Mikael are very legible and usually they wrote in good English, so it was not too difficult to read them. One of the things I learned when reading these letters is that on 5 March 1901 Anna wrote to Mikael that she had found Philippi material in Kützing's collection and later (a letter dated 11 July 1901) Mikael asked her to get a slide of a section of *Lithophyllum decussatum* from Philippi's collection. Thus, Woelkerling's find was a rediscovery.

I will introduce Mikael Foslie only by showing a portrait photograph he once gave to Anna, although no additional data are presented (Fig. 3). More about Anna Weber-van Bosse, however (see also Koster & van Benthem Jutting (1942) as well as the "Personalia" archives in the library of the National Herbarium of The Netherlands, University of Leiden Branch). She was born in Amsterdam on 27 March 1852. As a young girl (Fig. 4) in a well-to-do family she never went to school, but received a good education at home, for which a Swiss lady was responsible. Her interest in biology was quite clear and she often visited the nearby zoological garden, Artis, in her native city.

In 1871, when she was just 19 years old, she married a then well-known young painter, 24-year-old Wilhelm Ferdinand Willink van Collen. However, her husband soon became seriously ill. For that reason, they spent their winters in Mediterranean areas, but on 28 December

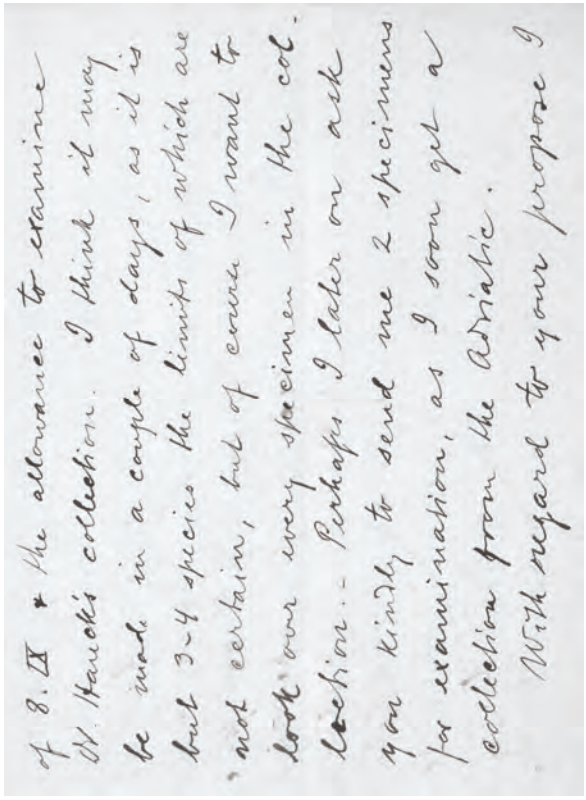

Fig. 1. Handwriting of Mikael Foslie (1855–1909). NHN archives.

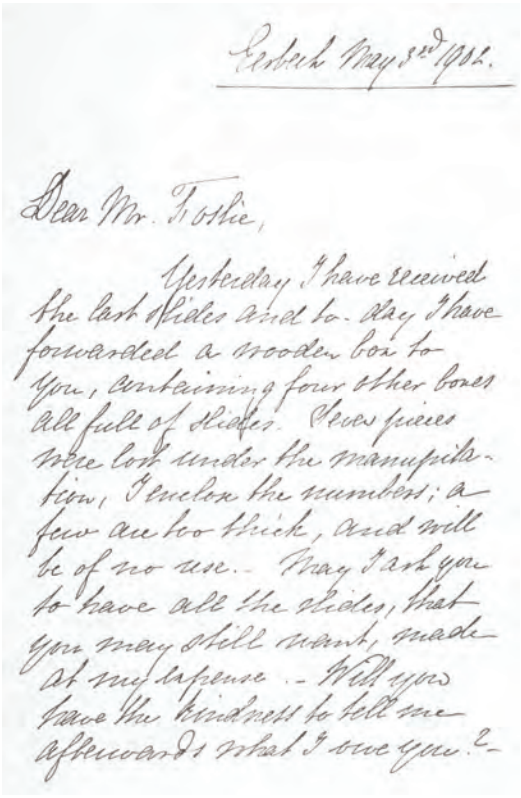

Fig. 2. Handwriting of Anna Weber-van Bosse (1852–1942). Copy from NTNU library in the archives.

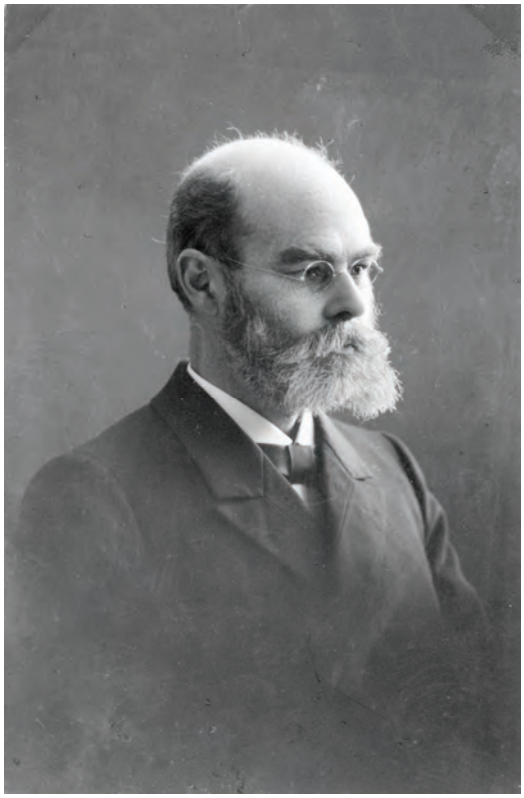

Fig. 3. Portrait of Mikael Foslie from Anna Weber-van Bosse's archives in the NHN archives. Possibly especially made around 1902 because Anna asked Mikael to send her a photograph.

Fig. 4. Portrait of Anna van Bosse as a young lady, made in 1900. NHN archives.

1877 her husband died. The now extremely rich widow returned to Amsterdam to live with her father – her mother had died already when Anna was less than 4 years old.

At that time it was not common for ladies to receive any higher education, but Anna managed to follow lessons in botany at an Amsterdam high school and in 1880, when she was 28 years old, she decided to attend lectures on botany at the University of Amsterdam. She did not have the required education, but universities then, too, needed money, and thus she was allowed to join as an informal, non-examinee student. Of course, ladies were not allowed to be in the same lecture theatre as male students when the professor was not present. Thus, Anna and two other ladies had to wait in a separate room until the professor was in the auditorium – only then could they also enter. Their practical lessons were held in a special ladies room.

Anna studied for several years with, among others, Professor Hugo de Vries, and after three years she decided to specialise in phycology, then only known as the study of algae. At the university, she met the young Professor Max Weber (Fig. 5), a zoologist with a German father and a Dutch mother, but had recently become nationalised as a Dutchman. They married in 1883 and soon after that they went on holiday to northern Norway, where Max Weber dissected some whales while Anna collected seaweeds around Tromsø. They seem to have liked that, and returned to Tromsø in the summers of 1884 and 1885. It is possible that they met Mikael during one of these holidays, but nothing has been written about that in the letters I have seen. However, on 11 April 1887 Anna wrote to Mikael to ask him to identify all her Norwegian algae, as well as specimens collected by her husband at Novaya Zemlya. There has been at least one earlier contact, because Anna thanks Mikael for his letter and for identifying the algae she had sent him earlier. She also said that she had decided to continue working on the small freshwater algae, which “also have their own charm”.

Expeditions to tropical regions

After the visits to northern coasts, the Webers wanted to see tropical regions of the world, and for Dutch citizens that was especially in what was then known as the Dutch East Indies, now Indonesia. In 1889, they left on a one-year trip through the Indonesian Archipelago, visiting the islands of Java, Flores and Celebes; the latter is now known as Sulawesi. They mainly studied inland waters, but Anna also collected some marine macroalgae.

Shortly afterwards, Mikael wrote a letter to Anna. She had already obtained a famous herbarium collection of algae. When the director of the National Herbarium in Leiden suddenly died (he was Willem Frederik Reinier Suringar (Fig. 6), who himself was a keen collector and well known for his studies of algae, especially from Japan), his widow sold his collection of algae to the only other phycologist in The Netherlands, Anna Weber-van Bosse. There is a story that she sold the collection to Anna for just one florin or one guilder, and that Professor Suringar had already proposed it. The sale included the agreement that, if Anna should want to part with these possessions, the first party concerned should be the National Herbarium, provided a curator was appointed to look after this large collection. And a large collection it was – not only the algae collected or obtained by Suringar himself, but also the famous herbarium of Friedrich Traugott Kützing (Fig. 7). Moreover, Anna herself had earlier bought another large herbarium, that of the Austrian phycologist Ferdinand Hauck (Fig. 8).

It was because of the Hauck collection that Mikael contacted Anna. At that time, Mikael was not yet so much involved in the study of coralline algae, although in September 1892 Anna com

Fig. 5. Portrait of the young couple, Professor Max Weber and Mrs. Anna Weber-van Bosse, in 1883. Artis Library, University of Amsterdam.

Fig. 6. Portrait of Professor W.F.R. Suringar (1832–1898), Director of the National Herbarium in Leiden, The Netherlands. NHN archives.

Fig. 7: Portrait, made 21 August 1868, of Dr. Friedrich Traugott Kützing (1807–1893), collector and phycologist. NHN archives.

Fig. 8. Portrait of Dr. Ferdinand Hauck (1845–1889), collector and phycologist. NHN archives.

pliments him especially on the quality of the photographs of calcareous algae (*Lithothamnia)* in his newest publication (Foslie 1890). Anyway, Mikael was most interested in seeing some of the algae, especially specimens of the green algal genus *Cladophora*, which had been studied and owned by Hauck. Anna had no official scientific position whatever in The Netherlands, but nevertheless many foreign phycologists wrote to her to borrow interesting material. Mikael wrote that letter to Anna in Norwegian, and he proposed to send her duplicates of algae he had collected in east Finnmark. I do not know what Anna replied or whether Mikael was able to borrow the material. However, that was most probably the case, because Anna was very eager to help other phycologists and did not need any financial compensation from them. In that period, Anna wrote her letters to Mikael in German. Later, most of their letters were in English, and quite formal. On 3 May 1897, a card from Anna to Michael starts in French, but after a few sentences she changed to English.

Most probably, Mikael visited the Webers twice. The first time was in 1892 when he made a trip to The Netherlands, England and Scotland after his appointment as curator in Trondheim. This was mainly to visit marine stations with aquaria in relation to the planning of a similar station in Trondheim. I will return to the second visit, in May 1901, later.

In 1894 and 1895, the Webers made a trip to South Africa, where for eight months they studied mainly freshwater lakes, but again Anna managed to collect some seaweeds.

After their visit to South Africa, the Webers wanted to see the East Indies again. Max Weber managed to get permission and funds to organise a marine expedition to the northern and eastern parts of the East Indian Archipelago with the naval vessel, the *Siboga* (Fig. 9). Anna was allowed to join her husband on board, which was certainly not normal in those days. The Siboga Expedition visited many coasts in the East Indies during its cruise of almost a year and much valuable knowledge was acquired and many interesting organisms were collected. Most of the results have been published in the Reports of the Siboga Expedition, a series in which volumes have been published until almost the end of last century. During the expedition, for which Max Weber wrote the official on-board report (Weber 1902) and Anna published a popular version of her experiences (Weber-van Bosse 1904). The commander on board, Lieutenant G.F. Tydeman, made his cabin available for the Weber couple and even slept at night on the dinner table on the rear deck. It was crowded on board (Fig. 10), but nevertheless much work was done there (Fig. 11). Try to imagine Mrs. Weber-van Bosse collecting in the field with the then prescribed long skirts – but she did so (Fig. 12).

The Siboga Expedition returned home with a large collection and the Webers decided not to stay in Amsterdam, but to move to their house in Eerbeek (Figs. 13 and 20) in the centre of The Netherlands. Anna immediately started her study of the Siboga algae. Max Weber was still Extraordinary Professor in Amsterdam, but the only thing he had to do there was to teach for two hours each fortnight, which he did on the Monday mornings.

Algal reefs – crustose Corallinaceae

At that time, not much was known about marine algae in tropical regions, although several international marine expeditions had already collected seaweeds. What astonished Anna most of all were the large quantities of coralline algae she found at almost all the stations where she was able to collect seaweeds. This resulted in suggestions to speak of the biotic reefs in the world as algal reefs, even for the well-known coral reefs (Hillis-Colinvaux 1986, Van der Land

Fig. 9. H.M. *Siboga* at work during the Siboga Expedition (1898–1899). From Weber-van Bosse (1904).

Fig. 10. The queen's birthday party in 1899 on board H.M. *Siboga*, with a visiting sultan and some of his retinue. From Weber-van Bosse (1904).

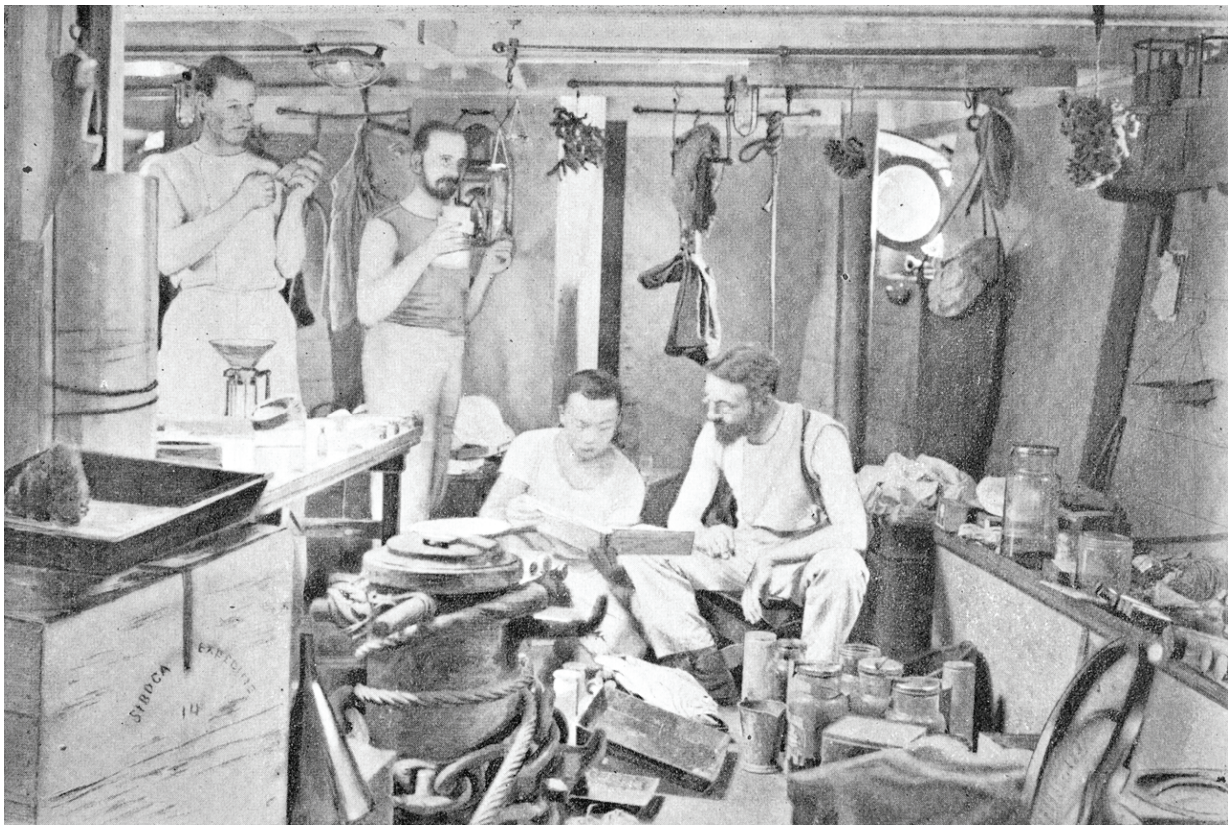

Fig. 11. On H.M. *Siboga*: men at work in the laboratory on board. From Weber-van Bosse (1904).

Fig. 12. Fieldwork on a beach with Anna Weber-van Bosse in long skirts. From Weber-van Bosse (1904).

1989). This is a conclusion that is still not accepted by many zoological colleagues, or the general public, but is, nevertheless, right. Anna soon published several pictures of interesting algal reefs (now better known as rhodolith reefs), especially those in Haingsisi, on Samau Island near the south-west point of Timor (Weber-van Bosse 1901, Plates XVIII and XIX, as well as Fig. 14 here).

On 30 August 1900, thus rather soon after the Webers returned from the Siboga Expedition, Mikael Foslie again wrote to Anna, once more asking to be allowed to see a number of algae that had been studied by Hauck, this time especially the crustose Corallinaceae. He proposed to visit The Netherlands to see this material. This letter is not in the archives in Leiden, but from Anna's reply of 8 September 1900 it is clear that it was a most welcome letter. Anna offered full hospitality to Mikael. He could stay in their house in Eerbeek and work in the laboratory the Webers had fitted out there. However, Anna explained in the same letter that she had also wanted to write to Mikael. At that time, there were in fact only two scientists working on crustose Corallinaceae, and both were interested in tropical Corallinaceae, too. One was Franz Heydrich in Wiesbaden, Germany, who had already published several papers on tropical algae, especially from New Guinea, and also on coralline algae from there, and the other specialist was of course Mikael Foslie himself. Now Anna asked Mikael to help her to identify the Corallinaceae collected on the Siboga Expedition, especially those from the Corallinaceae reefs, on which she would like to write a short note. Later, she would like to publish a larger account in the general "Liste des algues du Siboga" and she proposed that both her and Foslie's name would be given as the authors of that part. She wanted to arrange all the preparatory work, and then Foslie could name and describe the species. In his reply of 19 September 1900, Mikael accepted her proposal; he will name and describe the crustose Corallinaceae she sends him, but it is not necessary to add his name as co-author. He would like, however, to take photographs of as many specimens as possible for a future world monograph he wanted to publish on the crustose Corallinaceae.

Franz Heydrich

Almost all the letters they exchanged were quite formal, although often heartily so – except when they wrote about Franz Heydrich. In that same letter of 19 September, Mikael reproduces the opinion of the German phycologist Paul Kuckuck about Franz Heydrich – which was, of course, not very positive. In a return letter of 15 October 1900, Anna writes: "I have an inborn distrust of Mr. Heydrich. He wrote me such a superficial postcard". This postcard is in our archives (Fig. 15) and it is difficult to understand what was wrong with it. Anyway, Mikael and Anna were united in their distrust of Franz Heydrich. The debate between Foslie and Heydrich started before 1897, the year in which Heydrich published his first paper on Corallinaceae. Therein he stated that he had approached "unseren jetzigen besten Kenner dieser Gruppe, Herrn M. Foslie" and in a footnote he emphatically acknowledges him. Heydrich also wrote in a letter to Foslie (dated 31 March 1897, letter 0361 in Thor & al. 2005): "Ich bin sehr begierig zu hören wie Sie meine Systematik auffassen". The contact has not been as good as it seems and Foslie (1897a) did not accept the identification, separation and classification of the species and forms proposed by Heydrich (1897a). In his sharp reply, almost all Heydrich's points of view are rejected. His opponent, however, did not accept that (Heydrich 1897c), stating that he had asked Foslie to identify some specimens of calcareous algae that he, Heydrich, could not place. Foslie, however, had told him that most of the

Fig. 13. In front of the Weber-van Bosse family home in Eerbeek, The Netherlands, 26 March 1942. NHN archives.

Fig. 14. Rhodolith reefs in Haingsisi, an island near the south-west point of Timor. From Weber (1902).

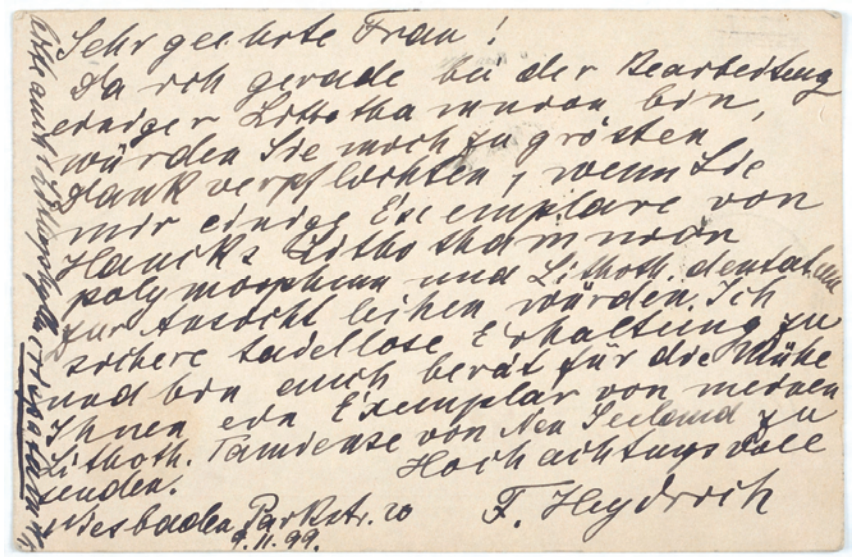

Fig. 15. Postcard sent by F. Heydrich to Anna Weber-van Bosse. NHN archives.

samples were just fragments and insufficient for identification, stating that sample material of good quality is necessary for correct identification. Heydrich had, nevertheless, tried to identify and classify the collected material. He was surprised that Foslie finally could use the fragments to state that Heydrich was wrong in many cases. The answer by Foslie (1898c) followed quickly, explaining, among other things, the poor quality of the samples that Heydrich had sent to him earlier. Luckily, Foslie had received better material from other collectors, which was why he could add observations about the correctness and quality of Heydrich's statements.

A new discussion started when Heydrich (1900a) explained why he thought that when classifying calcareous red algae it is better to separate the system for fossil representatives from that for Recent ones. Foslie (1900c) reacted immediately and the discussion went on and on (Foslie 1900d, Heydrich 1900b, 1901a). Mikael Foslie wrote to Anna that he had decided to deal a final blow in the debate, but the editors of the Berichte der Deutschen Botanischen Gesellschaft refused to accept this ninth and final polemic paper, which was too long and too unfriendly (letter 0959 in Thor & al. 2005) and they wanted the debate to be finished. However, the paper was published in the Kongelige Norske Videnskabers Selskabs Skrifter, the in-house scientific journal of Trondheim Museum. On the proposal of L. Kny, Foslie (1901c) changed the wording in his title from "glaubhafte Grundlage" to "sichere Grundlage". The very personal charge did not totally finish the debate, but certainly it became quieter. Foslie, however, kept his Franz Heydrich obsession for the rest of his life. Even in his last letter to Anna that is present in Leiden, dated 31 March 1909, Mikael states: "Mr. Heydrich is still curious...". Our principal characters were, however, not the only phycologists who were sceptical about at least some of Heydrich's results. In letters to Foslie, J.D.E. Bornet (France), F.C. Collins (USA), T. Reinbold (Germany) and N. Wille (Norway) also expressed this clearly.

Anyway, in May 1901 Mikael came to Eerbeek and the visit was successful. In a letter (in Norwegian) dated 6 June 1901, Mikael thanked her for the visit and repeated that in another letter, dated 26 June 1901. The latter was partly in Norwegian, partly in English. Anna replied (17 July 1901): "I was so glad to hear from you to know that you reached safely hjem. Enjoyed your visit very much ...". Mikael had asked Anna to try and get material on loan from Franz Heydrich, but she answered "I don't think that I may take the liberty to ask Mr. Heydrich for the species you want to see. He wanted formerly to exchange specimens with me and was very amiable, but I turned the cold shoulder upon all his advances having been told by a friend that he was not a perfect gentleman". Mikael, however, may nevertheless have persuaded her to write to Heydrich and shortly after Mikael's visit she did so. On 3 July that year, she received an answer from Heydrich. She wrote to Mikael: "I had a letter from Mr. Heydrich: he will send me the species I have asked for, and some four new ones, that are to be published next month, but I am to keep them for myself! I am not allowed to show them to anybody. This shows firstly that he does not trust his own species, or he would be glad to show them to everybody, and secondly that he is a hunter of new species making. I do dislike this kind of people so heartily...".

The big fault

In the next letters between Anna and Mikael, several different topics often reappear. In the first place, correspondence about photographs of a Giant Squid and also about an arm of that animal which Mikael sent to Max Weber. Furthermore, they often wrote about a tobacco box that Anna had asked Mikael to have made

in Trondheim for Max, who apparently had once seen or bought a similar one in Norway.

Soon after his return home, Mikael published a paper under the title “Three new *Lithothamnia*” in Det Kongelige Norske Videnskabers Selskab. He had made some proposals about that to Anna, but had not waited until the full answer arrived from Anna. She had proposed to call the new species *Lithothamnion annae* (after Mikael’s wife!), *Lithophyllum martinii* and *Lithophyllum reinboldii,* but Mikael preferred the designations *Lithothamnion pulchrum* and *Lithophyllum erubescens* forma *haingsisiana*, although he accepted the name *Lithophyllum reinboldii*.

In fact, the paper on three new *Lithothamnia* contained descriptions of four new taxa, because one had been added at the last moment. They were all published with the addition “A.Web. et Fosl. mscr.” In several later letters, Mikael excuses himself for what he calls “his big fault”. He had published them because he was afraid that Heydrich would publish new names for the same taxa. In fact, he was just in time, because the paper by Heydrich was published only two weeks later. Mikael repeatedly stated that he was sorry about not waiting for the reply from Anna, but that he nevertheless had been right in hastily publishing it. Anna did not show that she disagreed with him, but she did tell Mikael that it was not correct to add her name as an author of the new names – she had simply not done enough for that. Nevertheless, in her second part of the “Liste des algues du Siboga” (Weber-van Bosse 1921), she refers to “A. Weber & Foslie, Three new Lithothamnion”, which is, of course, not a correct reference.

In the last week of 1901, Mikael wrote that he was busy studying the Cape algae collected by Anna in 1884 and 1885. They also discussed the use of the designation *Lithothamnion* versus *Lithothamnium*. Mikael favours *Lithothamnion*.

In September 1901, Anna once again stated that she will not have anything to do with Mr. Heydrich. This time because he has sent her a “rude letter” (not present in our archives). Anyway, after getting that rude letter, Anna immediately returned all the specimens she had borrowed from Heydrich. Later, Mikael wrote to her that she had done well. He had understood, however, that she had also returned the specimens which Heydrich had once given to her. Mikael would never have returned those! Later in the correspondence, it becomes clear that Anna still owns the samples which Heydrich had given to her and that she had made slides of most of the specimens she had borrowed. However, Heydrich had forbidden Anna to show his specimens to Mikael. She never did this; she was a woman who kept her word, as she again said in her letter of 20 December 1903. In his reply, dated 29 December 1903, Mikael wrote that he understands and accepts that, but, he says, Heydrich did not say anything about slides, thus these could nevertheless be available to him (Mikael). It is a pity that no photograph of Franz Heydrich is available; not a single one seems to exist.

Further cooperation

The cooperation between Anna and Mikael changed in May 1902. Then Anna wrote to Mikael that she was not able to fully proceed with the study of crustose coralline algae. She proposed that Mikael would cover the crustose ones, and she herself would only do the geniculate Corallinaceae or Corallinaceae verae. Mikael accepted that proposal and later it becomes clear that he also prepared the photographs. Anyway, he produced the negatives and also had positives printed; these were sent to Eerbeek, from where the printing of the plates was organised. Anna wrote (in a letter of 12 December 1903): “I find your plates very beautiful and very instructive”. Mikael was also very happy with the results and wrote:

"These are the nicest reproductions of *Lithothamnia* that I have seen" and he wanted to buy the blocks (the clichés) to use them for his monograph. Max Weber gave him the blocks, without any cost involved. The Webers also paid for all the slides Mikael had made in Uppsala. He favoured ground slides; he thought decalcified slides were only acceptable for studying fertile parts.

Apart from the Recent specimens collected during the Siboga Expedition, Anna had also sent Mikael the specimens she had collected during her first trip to the East Indies, as well as fossils collected by geologists during an expedition to Dutch New Guinea. Where possible, all this material was also included in the 61st part of the Siboga Expedition series, which was the second part on marine algae published in the series (Weber-van Bosse & Foslie 1904). After much discussion, this book on the Corallinaceae had been published separately from the "Liste", with both authors as editors. Each of them, however, was responsible for a separate part of the text and the figures. Thus, Anna was not the co-author of all the new Foslie taxon names and Mikael had to organise the translation into English of his own texts. He found a teacher of English in Trondheim prepared to help him, but it was not easily accomplished and was very time-consuming.

The four parts of the "Liste des algues du Siboga" (Weber-van Bosse 1913–1928) were published much later and in French, which means that very few phycologists in Indonesia or surrounding countries can use these results at the moment. There is a good account by Verheij & Woelkerling (1992) on the preserved collections of specimens and slides of crustose coralline algae from the Siboga Expedition, to which I have nothing to add. Volume 61 of the Siboga series was sent to many phycologists around the world by Anna on behalf of both authors. Mikael wanted to pay part of the costs, but the wealthy Webers did not need that support.

In his letters, Mikael often wrote to Anna about his illnesses. He had been ill in spring and summer 1903 and later developed rheumatism, while his eyesight became steadily worse. He also often said that he was very nervous. He also informed Anna about an illness affecting his eldest daughter, who had problems with the big toe of one of her feet.

In 1907, Mikael upgraded several of the taxa of algae collected by Anna in South Africa from forms to species. He wrote in his last letter to her, dated 31 March 1909, that he was still taking photographs for his monograph and had 72 plates ready, ten of which were already printed and ten others were in the press. These were later used in the publication, "Contributions to a monograph of the Lithothamnia", an unfinished book which was published after Mikael's death (Printz 1929). For the manuscript of his monograph, Mikael Foslie used some of the Siboga plates without changing them, and for others he seems to have used the blocks of the Siboga Expedition together with new additions. Thus, in Plate 74 in Foslie/Printz (Fig. 16), figure 1 is new and the other figures are from the Siboga 61 volume, partly from its Plate 13 (Fig. 17), partly from text figures 27 and 28 in that volume.

It seems strange that Mikael never named any of his taxa after Max Weber or Anna Weber-van Bosse. He once (in 1903) proposed to Anna to describe a new genus as *Weberia,* but this never happened. Before he proposed this name for the new genus, he wrote in his letters about the problems he had in identifying three small specimens of calcareous algae collected by Dr. J. Stanley Gardiner in April 1900 in the Maldive Islands. One was, according to Mikaels' letters, a supposed new *Peyssonnelia*, which he also thought he recognised in slides of fossil material from West Papua (then known as Dutch New Guinea) prepared by Prof.

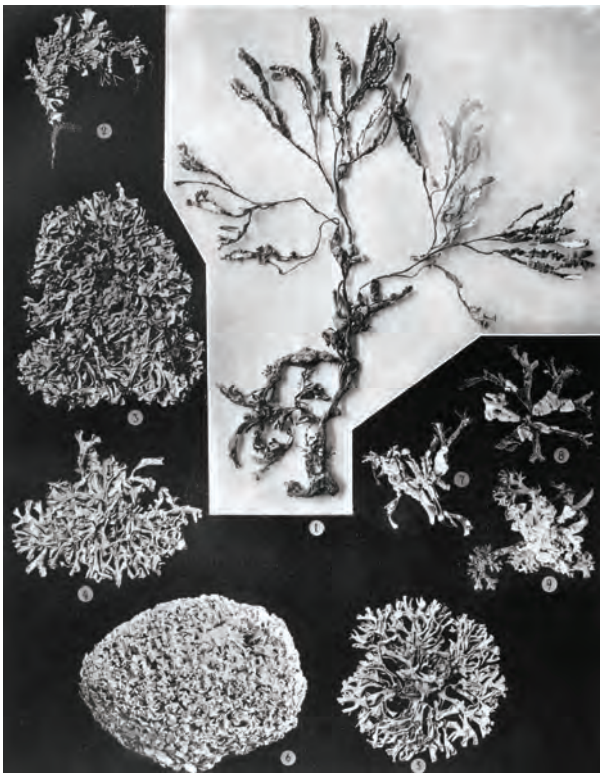

Fig. 16. Plate 74 in Printz (1929), which is partly new (its Fig. 1) and partly consists of figures reused from Weber-van Bosse & Foslie (1904), viz. Plate 13 and text figures 27 and 28.

Fig. 17. Plate 13 in Weber-van Bosse & Foslie (1904).

K. Martin in Leiden. In one of the letters (9 February 1903), Mikael wrote that he had seen two pieces in alcohol, one with cystocarps and one with probable antheridia. He proposed to name and provisionally describe it, although he offered Anna to do this if she should wish to prepare the description. Mikael thought that the new alga belonged to the Squamariaceae, a family of red algae on which he was not specialising. A day later, he wrote an extra postcard to tell her that he had made mistakes about the intended new genus: "The specimen with antheridia belongs to a species with overgrown sori (a member of the Squamariaceae), overgrown by Corallinaceae. The supposed carpospores are in fact tetraspores with indistinct partition". He still thought that it might belong to "a new genus, close to *Peyssonnelia"*. He told Anna that he wanted to publish it quickly, before Heydrich, who had described the related *Melobesia pacifica,* which belongs in the group of the Squamariaceae, would perhaps do so. In a return letter, Anna said she was happy that Mikael had found a new genus. She asked him to describe and publish it. Mikael suited the action to the word and in Det Kongelige Norske Videnskabers Selskabs Aarsberetning for 1902 he published data on the three small pieces of calcareous algae collected by dredging at 36 fathoms depth near South Nilandu, Maldives, by Stanley Gardiner. A preprint of this publication was separately printed on 12 February 1903. According to this publication, one of the samples contained a new *Lithothamnion* (*L. maldivicum*), the second a new *Hildenbrandia* (*H. lithothamnioides*) and the third a new *Mastophora* (*M. melobesioides*), while the original *Melobesia pacifica* was transferred to the genus *Ma-*

stophora, as *Mastophora pacifica* (Heydrich) Foslie.

The mail connection between Trondheim and Eerbeek was rather quick in that period. Mikael once asked for some material on a card written and posted on 8 February 1903. This card was stamped as incoming mail in Eerbeek on 12 February 1903 and Anna sent the material immediately, resulting in Mikael receiving it on 15 February in Trondheim. Nevertheless, occasionally messages crossed each other, thus when Mikael wrote again on 15 February 1903 he could not yet have received Anna's letter dated 14 February, where she said she was happy that the *Peyssonnelia*-like alga can be considered as a member of a new genus and that it will be named and described by Mikael. This is rather puzzling, however, because he had then already named and provisionally described it as *Hildenbrandia lithothamnioides*, at least according to the date of printing shown on the reprints. Soon after that (a card dated 20 February 1903), Mikael wrote a postcard again, proposing to call the new genus *Weberia*, although he had earlier provisionally named it *Placolithon.* He said that the "Aarsberetning" (the annual report of the museum), in which he wanted to publish the new name and provisional description had itself not yet been printed, but that he had a few (p)reprints of the botanical part. He wanted to distribute these as soon as he received the reprints of his Adriatic paper. However, the preprints of this Adriatic paper first became available one year later (Foslie 1904d). On 20 February 1903, he also wrote: "Therefore there is plenty of time to correage (! sic) the reprints, e.g. to write another name in the margin of the reprints. The Aarsberetning itself will not be printed within a month or so. I should like to give the genus another name – *Weberia*, as I hope it will be a good genus". However, in the preprint there was no proposal for a new genus *Placolithon,* but the new species *Hildenbrandia lithothamnioides* is in its place. However, Mikael wrote in that letter of 20 February: "If you allow me to name the genus after you, I suppose the two pagina of the "Aarsberetning" may be reprinted, retaining the date of issue when I do it soon. – I printed it at once, as I was afraid Mr. H. would do something similar....". . Anna accepted (in a return letter dated 24 February 1903) "with great pleasure" the dedication of the new genus *Weberia* by Mikael. She felt it as a "token of friendship". In Mikael's next letter (28 February 1903), he said he is glad that Anna accepts his proposal. He added: "Now it is only the question whether it is a good genus". Then he went on to write: "I have three small specimens from the Maldives which troubled me very much. One of the three specimens is a new *Hildenbrandia*". It is strange to imagine that he had printed his paper already two weeks before writing this letter.

This might have been discussed in subsequent letters, but Foslie's letters sent between 10 March and 8 July 1903 are lacking in the Weber-van Bosse archives. Mikael fell ill in March, mainly feeling quite nervous and troubled by problems with his eyes. He did not start to work again before October. Maybe one or two letters by Mikael to Anna are missing, because suddenly (28 May 1903) Anna wrote: "I am so sorry you trouble yourself about this new genus that you wanted to give my name. Your kind intention remains quite the same, please don't think anymore about it". Other letters and cards do not touch on the *Weberia* case, but Mikael later (5 November 1903) explained what had happened. He wrote: "You remember I wrote to you about the small specimens from the Maldives which troubled me extremely since the material was so poor. In spring I sent you a paper "Den botaniske samling", in which the one specimen is described as *Hildenbrandia.* Just as I had sent you and two other phycologists the

said paper, I found a specimen in your collection which made it probable that this *H.* was only an *Archaeolith.* in development. I at once printed a correction which I probably have not sent you before. Therefore I now send it in the parcel of photographs and beg you kindly to throw away the first you got. It was fortunately time to print this correction on the sheet itself in our "Skrifter" and therefore only mounted in the separate copies...". One of the other phycologists who received the preprint with the 12 February date on it was E. Bornet in Paris (see Woelkerling & Lamy 1998). He did not throw away the preprint, nor did Anna. However, in the preprint owned by Bornet a correction was glued stating that for "*Hildenbrandia lithothamnioides"* one should read "*Archaeolithothamnion* sp. (?)". This same correction was printed on the third sheet of "Den botaniske samling" in the volume of the "Aarsberetning" which was bound with the "Skrifter" published in 1903. In the Leiden library reprints, originally owned by Anna Weber-van Bosse, there is no trace of the correction, however.

In his 5 November letter, Mikael went on to say: "I prepared microtome-sections of this specimen and a Swede who is here in Valsö and has worked with algae examined the slides and found a remarkable likeness with *Hildenbrandia*. Prof. Wille also saw them this summer and found the form to be curious. But it is probably but an *Archaeolith.... .* It is at any rate bad that I should write about it. But as Wille remarked, I cannot be blamed for it when corrected at once". Anna immediately answered (11 November 1903): "How fortunate that you found out so soon this mistake about *Hildenbrandtia* (! sic). I don't think it can do any harm because you corrected it at once". The numbers of the specimens used to describe *Lithothamnion maldivicum* and *Mastophora melobesioides* can be found in the revised catalogue (Woelkerling & al. 2005, respectively p. 316, TRH B15–2563, and p. 28, TRH A1–38). There is, however, no material related to the original *Hildenbrandia lithothamnioides.* Maybe that under *Archaeolithothamnion schmidtii* f. *dissita*, Woelkerling & al. 2005, p. 483, TRH C19–3425 is this missing material.

Mikael Foslie dies

When Mikael Foslie died on 3 November 1909, he had been working all day in his laboratory on his monograph. From his letters to Anna Weber-van Bosse, it is clear that Mikael Foslie was a keen and enthusiastic scientist and a hard worker. He was a self-made man who discovered methods to study the rather unknown group of crustose coralline algae in a scientific way. His scientific attitude was two-sided, however. On the one hand, he easily changed his own ideas when new material or observations made that necessary, but on the other hand he did not easily accept critical remarks by others. He stated often that for good scientific work on the crustose Corallinaceae a great deal of suitable material was needed. He did not like to work with small specimens, although that was sometimes necessary. In some cases, he might have been too straightforward in telling corresponding phycologists that their material was not suitable for detailed studies. He had the disadvantage that he had a scientific journal at hand where he could publish almost everything he wanted without much (if any) peer review. The publication of his paper on three new Lithothamnia in 1901, which he himself later calls "his big fault", as well as his bungling about the suggested new genus *Weberia* showed that he often was too nervous to let his ideas mature before publication.

According to what I have read about the Webers, who never had children, they must have been people without enemies. For Anna, that was not completely true, for her feelings for Franz Heydrich did not fit that. I still do not fully

understand why, but in Foslie's case I understand his feelings in relation to Franz Heydrich much better. In the first place, these two men have thoroughly hurt each other's feelings in their polemic papers. Mikael Foslie was probably right when he considered the material Heydrich sent him for identification was unsuitable for that purpose. But it might have been better if Foslie has been less explicit in his published comments on the ideas of Heydrich. The result was that the only person who could judge the publications by Foslie in most cases did not like them at all. Foslie developed an obsession about Franz Heydrich. For Foslie, it was always clear from what side criticism came, because peer reviews and anonymous checking of manuscripts apparently did not occur in his circle. It is known to all who want to publish peer-reviewed scientific papers that reviewers may have strange misunderstandings about what one has written, but it is also known that one has to pass that stage to get something published. If such a procedure does not exist, later colleagues will at one stage or another detect mistakes and will discuss them, even when the original author is no longer able to answer. A paper like the present one might in part be considered to be a result of this absence of the peer-review procedure in the early 20th century.

How about Anna and Max? They both lived happily in Eerbeek (Fig. 18), where they were active in the laboratory (Fig. 19) and from where they published much. They often invited friends, colleagues and relatives. That happened for the last time on 26 and 27 March 1942 (Fig. 13). Max Weber, however, had died earlier, on 7 February 1937, but Anna celebrated her 90th birthday on 27 March 1942 (Fig. 20). Although The Netherlands were then at war and occupied by German troops, there was still enough meat and they grew many delicious things in their large garden in Eerbeek. However, half a year later, 29 October 1942, Anna died in peace.

Earlier Anna's eyesight became poorer and poorer, and in 1934 she sold her complete collection of algae, books and archives to the Rijksherbarium (National Herbarium) in Leiden, which is now the University of Leiden Branch of the National Herbarium of The Netherlands. As said before, she probably did so for just one guilder, now worth less than half a euro. The National Herbarium then appointed a curator for the algal collections, and that was Mrs. Josephine Th. Koster (Fig. 21). She had been the teacher and predecessor of both Professor Chris van den Hoek (Fig. 22) and the writer of the present paper, who has owed his agreeable position as a phycologist to both Professor Suringar and Mrs Anna Weber-van Bosse; a reason to be thankful.

Acknowledgements

The author thanks the staff of both the Gunnerus Library in Trondheim and the National Herbarium of The Netherlands, University of Leiden Branch (= NHN archives), for making available the letters exchanged between Anna Weber-van Bosse and Mikael Foslie, and the Artis Library of the University of Amsterdam, for the portraits of the married couple, Professor dr. Max Weber and Mrs. dr. Anna Weber-van Bosse. He thanks Mr. B.N. Kieft, photographer of the NHN, University of Leiden Branch, for his help with the preparation of the figures. The organisers of the symposium are thanked for their invitation to be involved in the symposium and especially the late Dr. S.M. Såstad will be remembered as an enthusiastic, friendly and caring host and organiser during the symposium and its planning phase. It was a pleasure for the author to be involved in this study of the history of phycology, and the National Herbarium of The Netherlands is thanked for permission to undertake this study and for facilities made available.

Fig. 18. Portrait of Professor Max Weber and Dr. A. Weber-van Bosse, made around 1930. Artis Library, University of Amsterdam.

Fig. 19. Drawing of Anna Weber-van Bosse, working in her laboratory in 1923, made by E.L.H. Woutersen-van Doesburgh.

Fig. 20. Front of the menu of the dinner given on the occasion of Anna Weber-van Bosse's 90th birthday on 27 March 1942, with a small portrait, made in 1941, of the celebrity and a photograph of the house in Eerbeek. NHN archives.

Fig. 21. Portrait, made in 1967, of Josephine T. Koster (1902–1986). NHN archives.

Fig. 22. Portrait, made in 1962, of Chris van den Hoek (born in 1933). NHN archives.

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On Mikael Foslie's work on non-coralline algae

Jan Rueness

Abstract

Rueness, J. 2007. On Mikael Foslie's work on non-coralline algae. – Gunneria 79: 56–66.

Mikael Foslie (1855–1909) published 12 scientific papers between 1881 and 1896 that dealt almost exclusively with non-coralline macroalgae from Norway. His later scientific works were devoted to coralline red algae. He described one new brown algal genus, *Ulonema* Foslie containing only one species *U. rhizophorum*, still a valid name. In addition, he described 16 other brown algal species, 5 red algal species, 9 species of green algae, and 1 blue-green, as well as 27 infraspecific taxa within the same groups of algae. Foslie's background and early career as a researcher is described and his early papers on non-coralline algae are analysed in the context of his time and of present-day knowledge.

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Introduction

The last part of the 19th century was the era of modernisation in biology. Taxonomy, comparative anatomy, histology, physiology, reproductive biology and evolution were new fields of study. A number of marine biology expeditions were undertaken and marine research stations were built. In Norway, Professor J.N.F. Wille (1858–1924), a botanist and specialist on algae, became one of the most influential biologists of his generation when he in 1893 succeeded Professor F.C. Schübeler as head of the Botanical Garden at the University of Oslo. From 1898, he was also director of the Botanical Museum (after Professor A. Blytt), and he was the father of the Botanical Laboratory, established in 1896, which he headed until the appointment of a new professor of botany in 1905. The new professor was H.H. Gran (1870–1955), also a phycologist, and best known as a pioneer of phytoplankton ecology. As early as 1885, Professor Wille had suggested that a marine biological station should be built in Drøbak on the eastern shore of Oslofjord. One of the other driving forces behind the establishment of biological stations in Norway was the explorer and scientist Fridtjof Nansen. Biological stations were opened in Bergen in 1892 and in Drøbak in 1894. Professor Wille was about three years younger than Mikael Foslie, and they developed a close friendship that lasted for about 30 years until Foslie's sudden death in 1909. Professor Wille (1911) wrote an obituary that is one of our best sources of information on Foslie's life and work based on first-hand knowledge (but see also Printz (1929) and Høeg (1943)). Professor Wille was internationally known as a botanist, and had a doctoral degree from 1885 on the physiological anatomy of the algae (Wille 1885). His main research interest was, however, green algae, and before he became a professor at the University of Oslo, he had worked for several years with Professor Wittrock in Uppsala, and later in Stockholm, Sweden. His treatise on the green algae in the classical standard work "Die Natürlichen Pflanzenfamilien", edited by Engler & Prantl (Wille 1890), is an indication of his international position. Whereas Professor Wille had an outstanding university career (he served as dean of the faculty in 1905–1906), Foslie was the amateur who became a world expert.

In 1874, at the age of nineteen, Mikael Foslie started work as a telegraph

operator during the Lofoten fisheries, and two years later was given a permanent position in the telegraph service at Lødingen (Lofoten) where he was employed until 1880. According to Wille (1911), Foslie showed a strong interest in natural history from boyhood, and collected plants and animals. For example, he had a large collection of birds' eggs that he had identified himself. His interest in seaweeds arose, again according to Professor Wille (1911), when he saw nicely pressed seaweeds in the home of his later wife, Anna Jensen. She came from the town of Drammen near Oslo, but worked as governess in Borge (Lofoten), where Foslie grew up. During the time he worked at Lødingen, Foslie collected and studied seaweeds in his spare time. However, he had very limited access to equipment and literature. According to Professor Wille, he constructed his first dredging equipment from an old travelling bag. In 1879, at 24 years old, Foslie visited Oslo for the first time. At the Botanical Museum there, he met Professor F.C. Schübeler, who himself had a keen interest in algae. The support and encouragement he received from Professor Schübeler was probably decisive for Foslie's continued work on algae. Professor Schübeler helped with literature and gave him access to the algal collections at the Botanical Museum. The following year, Foslie received his first grant from the University, which enabled him to undertake seaweed collections in North Norway, especially in the county of Finnmark. In the same year, he also went on his first journey abroad, to Sweden. With help from Professor Schübeler, Foslie was offered a position in the Oslo telegraph service in 1880. This enabled him to move south and dedicate most of his spare time to studies. He kept his position in Oslo for five years, until 1885. During these years, he examined the extensive algal collections at the Botanical Museum and studied the older Scandinavian literature dealing with seaweeds in Scandinavia. These studies resulted in a most useful catalogue (Foslie 1886) covering older finds of marine algae from Norway based on the older botanical literature and collections going back to "Flora Lapponica" by Linné (1737) and up to 1850. The year 1850 was chosen as the cut-off point because this was when Areschoug's thorough synopsis of Scandinavian seaweeds (Areschoug 1850) was published.

Early scientific work by Foslie

Foslie's first scientific publication appeared in 1881 and was written in Norwegian (Foslie 1881). It included results from his collections of seaweeds made in North Norway with support from the travel grant he received from the University in 1880. He described nine new taxa (see Table 1), including red, brown and green algae, among them *Polysiphonia schüebeleri* Foslie, a species named in honour of Professor Schübeler. In addition to samples from Finnmark, he also included descriptions of two brown algae from Borge in Lofoten (*Ectocarpus obovatus* and *Phloeospora lofotensis*). The paper was published by the Scientific Society of Christiania (now Oslo) and soon attracted the attention of prominent Scandinavian authorities on algae such as Professors J.G. Agardh in Lund, V. Wittrock in Stockholm and F.R. Kjellman in Uppsala. Professor Wille was at that time working in Sweden with Professor Wittrock. In summer 1881, Professor Wittrock visited Oslo, and together with Professor Wille and Foslie spent a few days collecting near Horten on the western side of Oslofjord. They collected specimens for Wittrock's Exsciccata (Wittrock & Nordstedt 1877–1903) and needed 70 pressed specimens of various forms of *Enteromorpha*. Professor Wille (1911) described how at the end of the day, both he and Professor Wittrock were too tired to continue working and went to bed, but not Foslie. Next morning, Foslie would have prepared all the specimens,

Table 1. Chronological list of specific and infraspecific taxa of non-coralline algae described by Mikael Foslie.

Publ. year	Species	Infraspecific taxa	Type locality	Current nomenclature if changed	Class	Comments
1881	*Bangia arctica* Foslie		Nordkapp, Finnmark, Norway	*B. atropurpurea* (Roth) C. Agardh	Rhodophyceae	
1881	*Chaetomorpha septentrionale* Foslie		Gjesvær, Finnmark, Norway		Ulvophyceae	
1881	*Chaetomorpha sphacelariae* Foslie		Honningsvåg, Finnmark, Norway		Ulvophyceae	Epiphytic on *Sphacelaria arctica* Harvey
1881	*Codiolum longipes* Foslie		Gjesvær, Finnmark, Norway	*Codiolum pusillum* f. *longipes* (Foslie) Collins	Ulvophyceae	
1881	*Dictyosiphon finmarkicum* Foslie		Sværholt, Finnmark, Norway	Reduced to synonymy with *D. chordaria* Areschoug in Foslie (1890)	Phaeophyceae	Placed in subgenus *Coilonema* Areschoug
1881	*Ectocarpus obovatus* Foslie		Borgevær, Lofoten, Nordland, Norway		Phaeophyceae	
1881	*Phloeospora lofotensis* Foslie		Borgepollen, Borge, Lofoten, Nordland, Norway	*Stictyosiphon lofotensis* (Foslie) Jaasund	Phaeophyceae	*Phloeospora tortilis* f. *lofotensis* in Kjellman (1890)
1881	*Polysiphonia schübelerii* Foslie		Russemark, Finnmark, Norway	*Polysiphonia elongata* f. *schuebeleri* (Foslie) Rosenvinge	Rhodophyceae	Species epithet should read *schübeleri*
1881	*Punctaria plantaginea* (Roth) Greville	var. *linearis* Foslie	Russemark, Finnmark, Norway	*Punctaria plantaginea* f. *linearis* (Foslie) Kjellman	Phaeophyceae	
1883	*Laminaria digitata* (L.) Lamour.	f. *longifolia* Foslie	Berlevåg, Finnmark, Norway	*Laminaria hyperborea* (Gunnerus) Foslie f. *compressa* Foslie	Phaeophyceae	
1883	*Laminaria flexicaulis* (Le Jolis) emend. Foslie	f. *valida* Foslie	Lofoten, Norway	*Laminaria digitata* (Hudson) Lamouroux	Phaeophyceae	
		f. *latilaciniata* Foslie	Russemark, Finnmark, Norway	*Laminaria digitata* (Hudson) Lamouroux	Phaeophyceae	*L. intermedia* Foslie in Foslie (1884)

Publ. year	Species	Infraspecific taxa	Type locality	Current nomenclature if changed	Class	Comments
1884	*Laminaria hyperborea* (Gunnerus) Foslie	f. *compressa* Foslie	Berlevåg, Finnmark, Norway		Phaeophyceae	
1884	Laminaria *gunneri* Foslie		Berlevåg, Finnmark, Norway	Laminaria nigipes J. Agardh (?)	Phaeophyceae	Status requires investigation
1884	*Laminaria digitata* (Hudson) Lamouroux	f. *grandifolia* Foslie	Berlevåg, Finnmark, Norway	*Laminaria digitata* (Hudson) Lamouroux	Phaeophyceae	
		f. *debilipes* Foslie	Finnmark, Norway	*Laminaria digitata* (Hudson) Lamouroux		
1884	*Laminaria intermedia* Foslie	f. *longipes* Foslie	Finnmark, Norway	*Laminaria digitata* (Hudson) Lamouroux	Phaeophyceae	
1884	*Laminaria saccharina* (L.) Lamouroux	f. *borealis* Foslie		*Laminaria saccharina* (L.) Lamouroux	Phaeophyceae	
1887a	*Chordaria attenuata* Foslie		Tovig, Troms, Norway	*Scytosiphon lomentaria* (Lyngbye) Link	Phaeophyceae	
1887a	*Coilonema filiformis* Foslie		Honningsvåg, Finnmark, Norway	*Dictyosiphon filiformis* (Foslie) De Toni	Phaeophyceae	Later finds?
1887a	*Pylaiella macrocarpa* Foslie		Troms, Norway	*Pylaiella varia* Kjellman	Phaeophyceae	
1887a	*Pylaiella curta* Foslie		Mehavn, Finnmark, Norway	*Fosliea curta* (Foslie) Reinke	Phaeophyceae	
1887a	*Spongomorpha minima* Foslie		Udvår, Vest-Agder, Norway		Ulvophyceae	
1887a	*Rhizoclonium pachydermum* Kjellman	f. *norvegica* Foslie	Nordkapp, Finnmark, Norway	*Cladophora pachyderma* (Kjellman) Brand	Ulvophyceae	see Nielsen et al. (1995)
1887a	*Codiolum cylindraceum* Foslie	f. *major* Foslie	Gjesvær, Finnmark, Norway		Ulvophyceae	
		f. *minor* Foslie	Vardø, Finnmark, Norway		Ulvophyceae	
1887a	*Codiolum intermedium* Foslie		Vardø, Finnmark, Norway	*Codiolum gregarium* f. *intermedium* (Foslie) Collins	Ulvophyceae	
1890	*Bangia virescens* Foslie		Finnmark, Norway	*Bangia atropurpurea* (Roth) C. Agardh	Bangiophyceae	

Publ. year	Species	Infraspecific taxa	Type locality	Current nomenclature if changed	Class	Comments
1890	*Codiolum brevipes* Foslie		Vardø, Finnmark, Norway		Ulvophyceae	= *Codiolum cylindraceum* f. *minor* in Foslie (1887a)
1890	*Diploderma amplissimum* (Kützing) Kjellman	f. *planiuscula* Foslie	Finnmark, Norway	*Porphyra amplissima* (Kjellman) Setchell & Hus ex Hus	Rhodophyceae	
1890	*Enteromorpha microphylla* Foslie		Berlevåg, Finnmark, Norway	*Ulva prolifera* O.F. Müller	Ulvophyceae	Synonymy acc. to Bliding (1963)
1890	*Halosaccion pubescens* Foslie		Syltefjord, Finnmark, Norway	*Devaleraea ramentacea* (L) Guiry	Rhodophyceae	
1890	*Leptothrix arctica* Foslie		Finnmark, Norway	*Heteroleibleinia rigidula* (Hansgirg ex Hansgirg) Hoffmann	Cyanophyceae	
1890	*Monostroma undulatum* Wittrock	f. *farlowii* Foslie	Finnmark, Norway	*Protomonostroma undulatum* f. *pulchrum* (Farlow) M.J. Wynne	Ulvophyceae	
1890	*Ptilota pectinata* (Gunnerus) Kjellman	f. densa Foslie f. distans Foslie f. kjellmanii Foslie	Finnmark, Norway Finnmark, Norway Finnmark, Norway	*Ptilota serrata* Kützing	Rhodophyceae	
1890	*Spongomorpha intermedia* Foslie		Kiberg, Finnmark, Norway		Ulvophyceae	
1891a	*Ascocyclus major* Foslie		Svinør, Lindesnes, Vest-Agder, Norway	*Hecatonema terminale* (Kützing) Kylin	Phaeophyceae	
1891c	*Isthmoplea rupincola* Foslie		Kjelvik, Finnmark, Norway	(?) *I. sphaerophora* (Carmichael) Kjellman	Phaeophyceae	
1892a	*Pelvetia canaliculata* (L.) Decaisne & Thuret	f. *radicans* Foslie	Levanger, Trondheimsjord, Norway		Phaeophyceae	Dwarfish, brackish-water form (see also Foslie (1894b))
1893b	*Laminaria schinzii* Foslie		Western South Africa	*Laminaria pallida* Greville	Phaeophyceae	

Publ. year	Species	Infraspecific taxa	Type locality	Current nomenclature if changed	Class	Comments
1894a	*Ceramium gracillimum* Harvey	f. *intermedia* Foslie	Oslofjord, Norway			
1894a	*Ceramium diaphanum* (Lightfoot) Roth	f. *patentissima* Foslie	Bodø, Nordland, Norway			
1894a	*Ceramium circinatum* Kützing	f. *tenuis* Foslie f. *genuina* Foslie f. *rigida* Foslie f. *divaricata* Foslie f. *borealis* Foslie		DNA sequences of herbarium material classified as *C. circinatum* from Norway identified as *C. virgatum* Roth (Skage 2001)		Probably not *C. circinatum* which is a southern species not recorded in Norway.
1894b	*Dichosporangium repens* Hauck	f. *varians* Foslie	Espevær, Hordaland, Norway	*Myriotrichia repens* Hauck	Phaeophyceae	
1894b	*Ectocarpus hanstenii* Foslie		Hisken, Hordaland, Norway		Phaeophyceae	
1894b	*Elachista moniliformis* Foslie		Medholmen, Hordaland, Norway	*Myriactula haydenii* (Gatty) Levring	Phaeophyceae	
1894b	*Monostroma fuscum* (Postels & Ruprecht) Wittrock	f. *tenuis* Foslie	Ålesund, Møre & Romsdal, Norway	*Ulvaria fusca* Ruprecht	Ulvophyceae	
1894b	*Myrionema intermedium* Foslie		Kilestrømmen, Hordaland, Bergen	*Myrionema strangulans* Greville	Phaeophyceae	
1894b	*Myrionema majus* Foslie			*Hecatonema terminale* (Kützing) Kylin	Phaeophyceae	Same as *Ascocyclus major* Foslie (1891a)
1894b	*Ulonema rhizophorum* Foslie		Lyngøy, Troms, Norway		Phaeophyceae	
1896b	*Ectocarpus turnerellae* Foslie		Trondheimsfjord, Norway	*Streblonema turnerellae* (Foslie) Printz	Phaeophyceae	
1905	*Peyssonnelia compacta* Foslie		Adriatic Sea	*Polystrata compacta* (Foslie) Denizot	Rhodophyceae	

carefully and expertly arranging and pressing each of them, as he always did in his own herbaria. Professor Wille (1911) used this story as an illustration of Foslie's boundless energy and patience.

During the five years (1880–1885) he worked in Oslo as a telegrapher as his main job, Foslie spent most of his spare time at the Botanical Museum, where he worked on the collections and had access to the botanical literature. He also participated in excursions led by Professor Axel Blytt. Each year, he received a travel grant from the University that enabled him to undertake fieldwork along the Norwegian coast, in Finnmark (1880, 1882, 1883) and along the Skagerrak coast (1884, 1885). In 1884, he again visited Uppsala and Stockholm in Sweden. In 1883 and 1884, Foslie published a monographic treatment of the genus *Laminaria* in Norway in two papers. The first of these was published in Norwegian (Foslie 1883) and the second (Foslie 1884), a 112-page paper with 10 plates, was published in German. Interestingly, nearly all of Foslie's later papers were published in English. In the last of the *Laminaria* papers, Foslie clarified species concepts and the nomenclature of the two species currently named *Laminaria hyperborea* (Gunnerus) Foslie and *Laminaria digitata* (Hudson) Lamouroux. The first of these had for a long time passed under the illegitimate name of *L. cloustonii* Edmonston, and the latter had been known as *L. flexicaulis* Le Jolis. With his good eye for variations of form, Foslie described several infraspecific taxa, and also two new species of *Laminaria* (*L. intermedia* and *L. gunneri*). He illustrated anatomical details such as growth rings in the stipe and the presence or absence of slime ducts in the lamina and the stipe. In a modern taxonomic context it is not possible to use the various forms as practical working units, but a great deal of information included in the detailed descriptions is still of interest. The problems related to species delineation and form variation within the digitata group of *Laminaria* in Norway were later approached by Sundene (1958, 1964) and Svendsen & Kain (1970), who used culture and transplant experiments, and by Munda (1965), who examined anatomical details and used the benzidine reaction test on herbarium specimens from Foslie's herbarium.

Curator at Tromsø Museum (1886–1892)

In 1885, Foslie was offered a position as curator at Tromsø Museum as the result of an application from the museum directly to the Storting (Norwegian parliament). Foslie was mentioned as the person they wanted in the position, and Professors Schübeler, Blytt and Wittrock wrote covering letters of support. For two months during winter 1885–1886, Foslie visited England and spent most of the time collecting seaweeds on the Isle of Wight. A list of his finds was later published (Foslie 1893a). The following spring, in 1886, Foslie married Anna Jensen, and they moved to Tromsø where he served as curator at Tromsø Museum for about seven years. He was not only head of the botanical section at the museum, but also curator of the bird and mammal collections and the museum librarian. As a result of his many expeditions to Finnmark (5–8 weeks each year in 1882, 1887 and 1889), he published a 186-page account (Foslie 1890) of benthic marine algae, including Cyanophyceae, from the eastern part of Finnmark (from Sværholt to Jakobselv). Very little was known about the algal flora of this part of the Norwegian coast, and even today very little has been added. During the period in Tromsø, Foslie also published various algal observations made on different parts of the Norwegian coast (Foslie 1891a, b, c, 1896a, c) and popular scientific papers (Foslie 1887b, 1892b). His particular interest in the crustose corallines was clearly reflected for the first time in Foslie (1891a).

Curator at the Museum in Trondheim (1892–1909)

In 1892, Foslie was appointed as curator at the museum in Trondheim where he worked for 17 years until the day of his death. In this period, Foslie worked almost exclusively on coralline red algae and published about 70 papers on this group of algae. These publications and Foslie's extensive herbarium of corallines kept at the museum in Trondheim have been thoroughly analysed (see Woelkerling 1984, 1993, Woelkerling & al. 2005).

The red algal genus *Ceramium* is an intriguing group, and Foslie (1894a) was the first to analyse species from Norway based on material from the museums in Oslo and Bergen and some contemporary collections by Professors Gran, Wille and B. Hansteen, in addition to his own collections. *Ceramium* is one of the most species-rich genera of red algae and has a worldwide distribution. Specimens are easily recognised at genus level, but the taxonomy at species level is extremely complex and still very much in a state of chaos. Foslie (1894a) recorded a total of 11 species from Norway, and he described several infraspecific taxa (Table 1). In a later revision of the Norwegian *Ceramium* species by the Danish *Ceramium* specialist H.E. Petersen, the number of species was increased to 19 (Petersen 1925). Two of the species that were included by Foslie (1894a) were considered doubtful records by Petersen (1925), i.e. *C. echinotum* J. Agardh and *C. flabelligerum* J. Agardh. Modern DNA analyses and hybridisation studies have helped to resolve many of the taxonomic problems within *Ceramium* (and other algal groups) in recent years (Maggs & al. 2002; Gabrielsen & al. 2003; Skage & al. 2005). Using DNA techniques, Skage (2001) succeeded in extracting DNA from some of the same herbarium specimens as those studied by Foslie (1894a) and Petersen (1925). The following are two examples of the results obtained from sequencing the plastid DNA Rubisco spacer: a specimen collected by Wille near Horten in Oslofjord and classified by Foslie (1894a) as *C. circinatum* f. *rigida* Foslie was placed in *Ceramium septentrionale* by Petersen (1925). From the Rubisco spacer sequences derived from the same specimen, the alga could be identified as *C. virgatum* Roth (= *C. rubrum* nom. illeg.). Another specimen collected by Foslie at Svinør on 17 August 1885 (county of Vest-Agder, Norway) was classified by Foslie (1894a) as *Ceramium rubrum* (Hudson) J. Agardh f. *decurrens* J. Agardh. In Petersen (1925), the same alga was transferred to *Ceramium fruticulosum* Kützing f. *dichotoma* H. Petersen. Rubisco spacer sequences placed the alga in *Ceramium pallidum* (Nägeli ex Kützing) Maggs & Hommersand. These examples show that the morphological criteria for distinguishing species of *Ceramium* as used by both Foslie and Petersen were insufficient. *Ceramium* species are unusually morphologically variable and certain taxonomic characters previously considered significant, such as the details of cortical filament development, are of little practical value in delimiting species.

A summary of the non-coralline algal species and infraspecific taxa described by Foslie is presented in Table 1. The monotypic genus *Ulonema* Foslie, with the species *U. rhizophorum* Foslie, is still a valid name. The species is found as an epiphyte on *Dumontia contorta* (Gmelin) Ruprecht, where it forms minute brown spots. Outside Norway, the alga has been recorded from the Swedish west coast, Britain, Ireland, The Netherlands, and also from Nova Scotia on the western side of the North Atlantic.

Foslie described a total of 32 new species and 27 infraspecific taxa of non-coralline algae and published the details in 13 papers between 1881 and 1892 and one in 1905. Foslie's herbarium of non-coralline algae contains numerous specimens from collections both in Norway and abroad. Only a few of these

have been ordered and reviewed (Munda 1964). Many of the taxa described by Foslie have not been recorded after their description, but their autonomy is retained pending further studies. The following entities of non-coralline algae have been named after Foslie: *Fosliea* Reinke 1891 (Ectocarpales, Phaeophyceae); *Ceramium fosliei* Petersen in Hygen & Jorde 1935 (basionym: *Ceramium septentrionale* Petersen f. *fosliei* Petersen 1925) (Ceramiales, Rhodophyceae); *Urococcus foslieanus* Hansgirg (uncertain taxonomic status), *Protococcus marinus* Kützing f. *foslieana* Hansgirg (= *Chlorococcum submarinus* Ålvik, Chlorococcales, Chlorophyceae).

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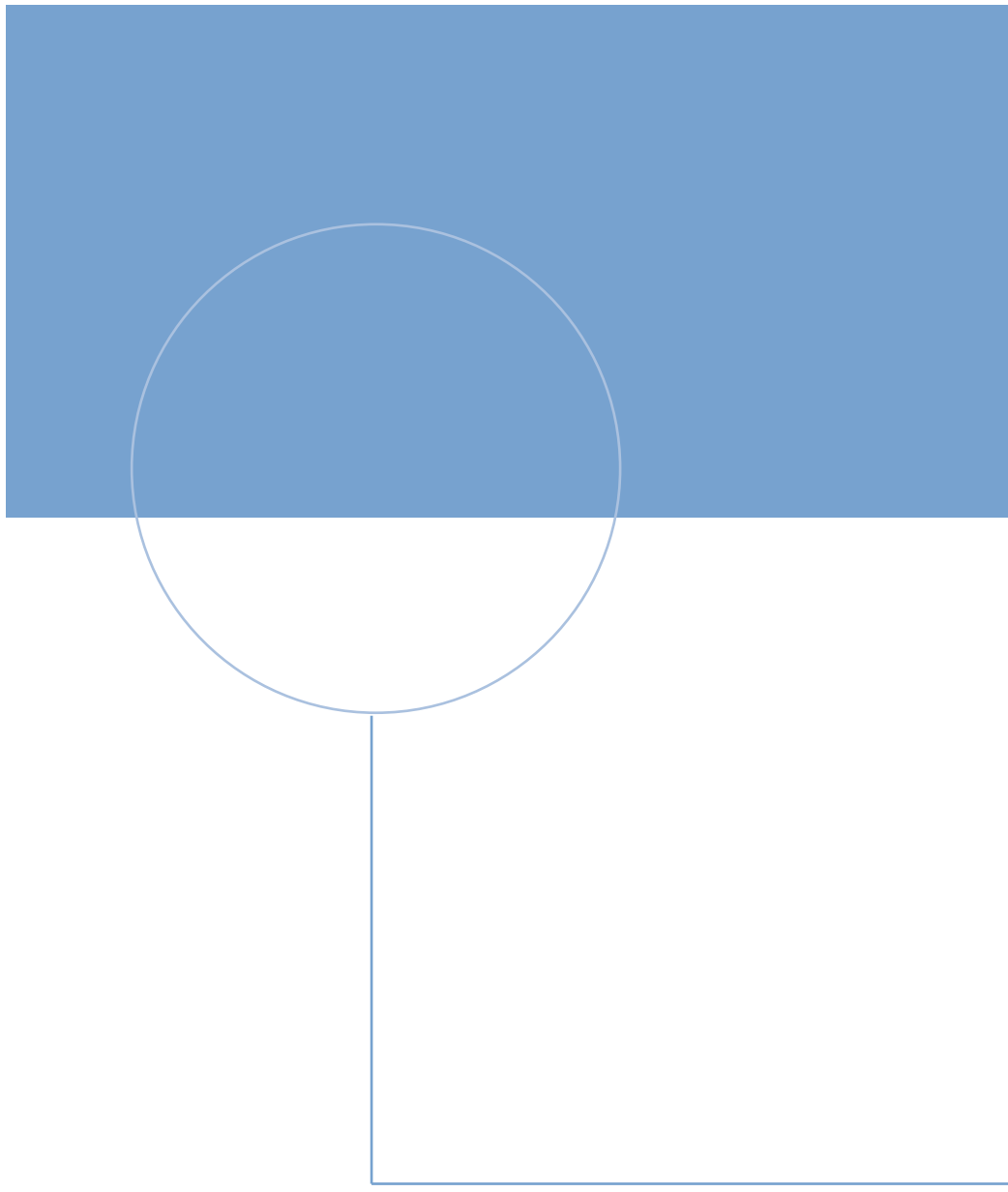

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